THE

FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE USEFUL ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

OCTOBER, 1827.

Description of a furnace for smelting Iron, by means of Anthracite. By Joshua Malin, *Engineer.*

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir,

I have the pleasure of sending you a plan of a furnace for smelting iron ore with anthracite. I have been under the necessity of finishing the drawing rather hastily, but hope, however, that it will be found to be sufficiently descriptive. You will perceive that in its construction, it is, in general, similar to the common blast furnace: the crucible, and hearth alone, differing materially. The crucibles of these furnaces, both American and English, are square; but in this, it is round, and it must necessarily approach this form when anthracite is to be used; this coal is so much more dense than either coke, or charcoal, that its weight causes it to descend in the corners, or angles, of a square hearth, where, being screened from the intense blast which is required, and carrying with it a portion of the unmelted ore, it mixes with, and chills a quantity of the fused ore, and metal, and stops the operation of the furnace.

For the smelting by means of anthracite, the blast must be introduced under a pressure of, at least, two and a half pounds to the circular inch; and the quantity required for a common sized furnace, will not be less than twenty-eight hundred cubic feet, per minute; or seven cubic feet per minute, for every circular inch in the area of the hearth, at the tuyere. Common sized hearths are about 20 inches in diameter; $20 \times 20 = 400 \times 7 = 2800$ feet; this, I think, will be found to be a good proportion.

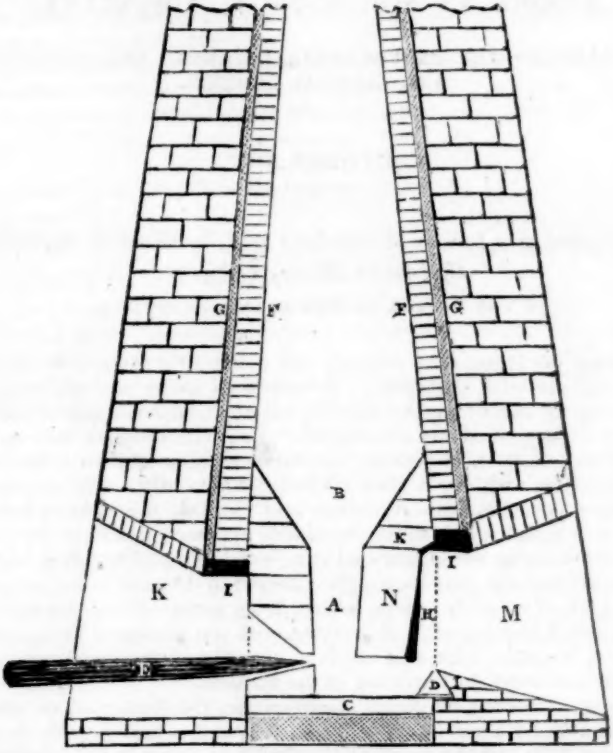
The hearth of the cupola, or furnace, in which I tried many of my experiments, was only eleven inches in diameter, at the tuyeres; the

blast being introduced as represented in the accompanying plan: I increased the diameter to fourteen inches, and found that the blast which I had at my command, would not enable me to go beyond this point, as, when I attempted it, the scoria, and metal, chilled, and formed a tube from the tuyere, a part of the way across the hearth.

An elliptical hearth will undoubtedly answer, by introducing the blast, with the tuyeres placed opposite to each other, at each end of the oval; I am of opinion, however, that the circular form will be found to be the best.

JOSHUA MALIN.

Lebanon, Pa., May 24th, 1827.



The letters of reference exhibit the same parts both in the horizontal, and vertical sections, when they are found in both. The figures are drawn to a scale of an eighth of an inch to the foot.

A, The crucible, being a part of what is commonly called the hearth of the furnace.

B, The boshes, or part where the metal passes from the solid to the fluid state, as it descends.

C, The bottom stone of the hearth, bedded on sand, and supporting the crucible, and boshes; these are made of the best stone for standing fire. Whenever the hearth requires to be renewed, this stone, together with those forming the crucible, and boshes, have to be removed, the rest of the stack remaining permanent.

D, The dam-stone, supported on the outside by brick work, on which rests a cast iron plate, kept covered with coal dust, on which the scoria flows down.

EE, The pipes by which the blast is introduced.

FF, The in-walls of the furnace, made of fire-brick, or of sandstone, but preferably of the former.

G, A space, from 4 to 6 inches wide, filled with soft sandstone, broken fine, to allow of expansion, and contraction.

H, The tymp-plate, of cast iron, to support the tymp stone.

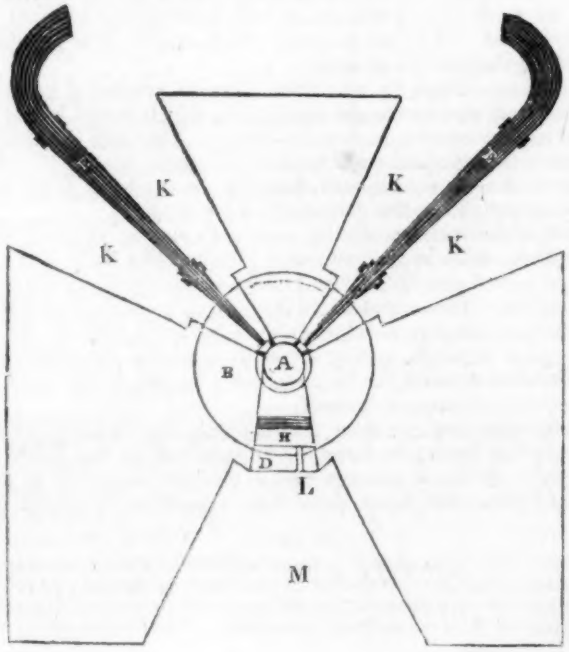
II, Cast iron lintels to support the in-walls over the tuyere, and tymp arches.

KK, The tuyere arches.

L, The part where the metal flows out.

M, The tymp arch. (This in Mr. Strickland's reports, is called the lymp arch, but the common name with us, is tymp arch.)

N, The tymp stone, forming a part of the crucible, and supporting a part of the boshes.



Essay on Earthenware and Porcelain.

[From Parkes' Chemical Essays.]

(*Continued from page* 152.).

Nothing is found to answer so well for making the potter's moulds as plaster of Paris; because, when rightly prepared, it has the property of absorbing the water so very rapidly from the ware, that it occasions it to slip out of the mould, or to *deliver* itself easily, as the technical phrase is.

To prepare the plaster for making the moulds, it is first ground in a mill exactly similar to that which is generally used for grinding corn by means of a pair of flour stones; it is then baked, or rather boiled,* to expel the water, which is one of its component parts when in a native state.

This plaster, which is the native sulphate of lime, is boiled in very long brick troughs, having a fire flue running underneath them. The man who superintends the process, has a handkerchief tied over his mouth for safety; as the small particles getting upon the lungs, or into the stomach, have been found to be very injurious to the health of the operator.

When this plaster has been thus deprived of water, it is in the state of a soft and impalpable powder; and if its own proportion of water be again mixed with it, it will immediately set into a hard compact mass. It is this property which renders it so peculiarly fit for making the potter's moulds.

The manipulations by which the different articles of earthenware are made, are so various and multiplied, that it would be very difficult, if not impossible, to describe them. They can be known only by those who have had opportunities of visiting a pottery. A short outline of these processes will, however, be expected from me, and may be acceptable to the generality of my readers.

Much of the common earthenware is formed by means of the potter's wheel, which is a round board attached to a lathe, and capable of being moved thereby, either rapidly or otherwise, as the occasion may require. This round board moves in a horizontal position; and when in use, the clay which is to be fashioned is fixed on the centre of it; and it is put in motion either by a person who constantly attends it when at work, or by means of a treadle which is moved by the foot of the workman himself.

As the clay revolves upon this machine, the workman either models it by his fingers, or forms it, by means of an instrument which he holds in his hand, into any kind of circular shape that he may desire; and when the object is to make a number of vessels exactly

* *Boiled.* This may appear to be an incongruous expression when applied to a dry earthy substance; but the fact is, that when the ground plaster is heated it has so much the appearance of ebullition, that the term which I have employed is made use of by the workmen universally. The finished article is always called *boiled plaster.*

similar to each other, the size is generally determined by a guage fixed without the circumference of the revolving wheel, but projecting over it in such a manner, that, whenever the yielding clay is spread out until it touch this guage, the artist knows that the article which he is making has attained the exact figure which he intends.

The potter's wheel is probably the most ancient of the manufacturing instruments now in use. It was known to the author of that book in the Jewish Scriptures, which claims the highest antiquity of any writings we have, and who must have lived at least 3000 years ago. This simple instrument has, however, of late years been much improved by adapting a strap to it, which passes over a large taper cylinder of wood, by means of which the artist is enabled to increase or diminish the rapidity of the motion at pleasure. This contrivance is known to mechanics by the name of the *cone pulley*.

In going through a pottery, it will be observed, that all the articles are very thick and coarse when they come from the wheel. This perhaps is unavoidable. They are therefore taken to a lathe, where the extra quantity of clay is removed, in the same manner as the wood-turner forms his work by shaving off successive portions of the wood. These parings of clay are afterwards kneaded as before, and then worked over again for similar purposes.

It is curious to notice the great variety of circular things that may thus be made by means of the potter's wheel; but it must be remembered that this machine is calculated only for cylindrical, conical, or round articles, and not for such as are of an oval or an irregular form. All such are made in plaster moulds, which divide in halves for the convenience of taking out the ware whenever it is found to be sufficiently dry to be removed. The handles of cups and jugs are also made in moulds, and these are afterwards put on the vessels for which they were designed.

The consumption of sulphate of lime, gypsum, or alabaster, (for this substance is known by these various names,) is so considerable for making the moulds for plates and dishes, that in the course of the year many tons of worn out moulds are thrown away as useless. I would suggest, that these might be ground and used as manure, instead of purchasing fresh gypsum for that purpose.

As the plaster moulds absorb water with avidity, the articles which are made in them dry much sooner than would generally be imagined. For instance, the moulds on which the common table-plates are formed, are put into a very temperate stove as the plates are made, and in about two hours the whole will be dry enough to be removed to make room for a fresh parcel. In the usual way of conducting a manufactory, every mould is capable of taking four or five fresh plates in the course of a day of twelve hours. The plate-stove is generally a very small room built with bricks, and shelved with boards from the floor to the ceiling. It is usually heated by an iron pipe which passes through it.

When the plates are removed from this stove, they are taken off the moulds, and pared round the edges with a small knife; and when

they have been slightly polished by the hand, they are laid by to become hard enough for the biscuit oven.

From this short account it may be easily conceived that a common-sized pottery must require a great deal of room, especially as every article, whether made by the wheel, the lathe, or the moulds, must be spread out upon shelves to dry: and this reminds me of an expedient which I lately observed at the works of an ingenious potter in Staffordshire, and which I conceive to be so far an improvement upon the old practice, as to deserve being mentioned, and which I have the leave of the proprietor to make public.

The improvement to which I refer, is that of having a chamber shelved entirely round, not with stones or boards as is usual, but with shelves of prepared plaster made as smooth as polished marble, and of the thickness of an inch and a half each.

Upon these plaster shelves, instead of those of wood and stone as commonly adopted at other works, the goods are placed to dry: and the great advantage which must accrue to the manufacturer from the practice is very obvious; for the plaster not only absorbs the water sooner, but the articles will dry more regularly and uniformly than they possibly can when placed upon substances which cannot abstract the water. Being persuaded of the utility of this expedient, I have no hesitation in recommending it for general imitation. Moreover, why may not the floors of a potter's warehouses be covered with plaster? The expense would be very inconsiderable, and then, whenever these were not in use for storing the finished ware, they might be advantageously employed in hastening the drying of the goods newly made.

In some countries it is usual to form the floors of cheese chambers with plaster, and I have been told that the cheese becomes sooner ripe on these floors than on others; though Mr. Twamley directs that it should not be placed on plaster until time has been allowed for the first moisture to exude and evaporate.*

An important improvement might be made in the manufacture of earthenware, if it were possible to contrive an expeditious mode of spreading the goods out so as they might always dry gradually. The property which clay has of contracting by heat or by drying, is well known, and the excellence of earthenware depends in a great measure on its being very *gradually* dried before it be exposed to the kiln.

When the articles of pottery have been modelled or fashioned to the design of the artist by any of the foregoing methods, and have been partially dried, either by an exposure to the action of the atmosphere, or by placing them for a certain time in stoves or drying rooms constructed for the purpose, they are carried to the potter's oven, where they are placed in deep, oval boxes, made of fire clay. These are called *seggars;* and being flat at bottom, one of these vessels forms a cover for another, so that the workmen are enabled, without difficulty, to place them in piles nearly to the top of the oven,

* Josiah Twamley *On Dairying*, 8vo. Warwick, 1784, p. 100.

which is a large building of brick, in the form of a cone, and very similar to a common glass-house.

When the oven is properly filled, heat is applied by means of ignited coal, which is thrown into several receptacles built on the outside, but communicating by means of flues, with the inner part. These are called *mouths;* they stand about four feet in height from the ground, and project about three feet from the sides of the kiln.

In the beginning, the heat is kept at a low state; but after a lapse of twelve hours it is gradually increased, and the augmentation of temperature is continued until the kiln, and its contents, acquire the proper maximum.

An attention to the degree of baking is an object of extreme importance. Vauquelin has remarked that "the heat should be such as to expel the moisture, and agglutinate the parts which enter into the composition of the paste; but incapable of effecting the fusion, which, if too far advanced, will render the ware of so homogeneous a texture as to become brittle."*

It has been found that alumina loses 0.46 of its weight even when the fire is not urged beyond the temperature of ignition for silver; whence it appears that it contains nearly half its weight of water, and it does not part with the last portion, but with great difficulty.

The operation of burning usually lasts two days and two nights. This, however, varies in the different charges; and the fireman judges when the ware is sufficiently burnt, by examining the trial pieces which are placed in those parts of the oven where they may be taken out with ease, and without causing any diminution of the heat.

These trial pieces are made of the common red clay, of the Staffordshire brick-makers. It is found in the Potteries, and has the property of changing its colour at every change of temperature: therefore, by comparing one of these, taken out of each part of the oven, with a trial piece made of the same kind of clay and properly burnt, and which is kept on purpose for a standard, the state of the ware under operation, may, at any time, be exactly known.

All the common ware undergoes two firings: that is, when it has been sufficiently dried in the air, it is put into an oven and made into what is called *biscuit*, which is earthenware partially burnt.

Many ladies are in the habit of buying china in the state of biscuit, for the purpose of painting and gilding. When they have imparted their own designs, these are sometimes returned to the potter, who burnishes the gold and completes the baking. This is mentioned with the view of directing those females who may not be already acquainted with it, to a new object for the exercise of their taste and genius, and also for the better explanation of the nature of biscuit ware.

All the English earthenware and china undergoes this previous firing, because, were it not first made into *biscuit*, it would not bear

* Vauquelin's *Reflections on the Qualities of Pottery*, communicated to the Philomathic Society at Paris.

to be immersed in the mixture of lead and water, called the glaze, without suffering injury thereby: that is, it would not fail to be rendered soft, and liable to be put out of form, by its absorption of the water. Neither would it sustain the process of printing, nor allow of its being painted upon with any good effect.

The composition of the Chinese porcelain is different, and its nature is now pretty accurately known. Mr. John Bradley Blake, who was settled as a resident supercargo at Canton, and died there at the age of 29, sent, a short time before his death, to Mr. Samuel Moore, the then Secretary to the Society for the Promotion of the Arts, specimens of the earths, clay, sand, stones, and other materials used in making the true Nankin porcelain, all which Mr. Moore put into the hands of the late Mr. Wedgwood, who from these materials produced some pieces of excellent porcelain, and declared that those earths were so complete a set of specimens, that he had no doubt of their being the true materials of the Oriental porcelain. Had Mr. Blake lived, further information would have been procured.

It was ascertained by Mr. Blake, and we have learnt from other sources, that, in China, the earthenware and porcelain are merely dried in the air before glazing; as their composition so effectually resists water, that it can be immersed in an aqueous glaze, without being first made into biscuit, and consequently that the Chinese are enabled to burn their ware by one single firing.

It is therefore a desideratum with the potters of this country, to find some substance to mix with the clay which shall give it the property of resisting the action of water before it has undergone the first burning. This would be a great acquisition to our English manufacturers, because it would not only be a saving of fuel, but a great economy of time and of the expense of wages, as one operation would be thereby entirely saved.

Dr. Woodward mentions the Soap Rock at the Lizard Point, and the steatites in other places, as very likely to make good porcelain. Dr. Campbell also, who seems to understand this subject, strongly recommends this article to be employed in the manufacture of china. Whether steatites will improve the body of the ware, as above mentioned, I do not know, but I know it has been used at some of our porcelain works in considerable quantities.

Should the English potter be able to make the body of his ware equal to that of the East, it would then be necessary, as I apprehend, to discover some other material for the glaze; because, if our ware were burnt, as it is in China, by one operation, the earth would contract more than the glaze, and consequently the latter must either crack, or partially fly off.

I hazard this opinion, because I know that in China the glaze is infinitely better than ours, inasmuch as it consists purely of fel-spar, and is so extremely hard that it cannot be operated upon by any of our common cutting instruments. Even the wheel of the glass-

grinder will not touch it; whereas ours becomes scratched and defaced, by common usage and ordinary wear.*

If the glaze on porcelain be too thick, this will occasion it to break; it is therefore important to apply a thin glaze, the fusibility of which should be as nearly as possible approaching to that of the body of the ware, in order that the combination may be more intimate and lasting. Chaptal, describes a glaze which perhaps our potters may imitate with advantage. "It consists," says he, "in mixing the earth of Murviel in water, and dipping the pottery therein. When dry, they are plunged into a second water, in which levigated green glass is mixed. This covering of vitreous powder fuses with the clay of Murviel, and the result is a very smooth, very white, and very cheap glazing."

The great durability of the Oriental china is its main excellence. We make porcelain in this country which is equally beautiful; and, if the symmetry of the figures and the merit of the painting be considered, far more elegant, although it possesses a less degree of tenacity and hardness.† We have, indeed, lately noticed the introduction of what is called stone-china, which is made very thick and clumsy to imitate some of the best productions of the East: the glaze upon this, however, is as poor and soft as upon other English china.

Is it not natural then to ask, Why do not our potters make use of a better glaze,‡ especially as the county of Cornwall can furnish felspar in abundance and at a reasonable price?

The true answer to this question seems to be this; that our ovens are not capable of fusing a glaze similar to that which is employed in China.§ The heat of the potter's oven in that country must be tremendous. The materials could not be vitrified as we see them, with less heat than would fuse Cornish granite.

An ingenious mode of discovering when the glaze on china is not sufficiently hard, has been given by the late Mr. Nicholson. It consists in dropping a small quantity of strong ink upon it, drying this before the fire, and then washing it. If the glaze be too soft, an indelible brown stain will remain upon it.

It must here be remarked, that for those who choose to incur the

* This remark is not applicable to all the European porcelain; for that made in Saxony, and in some other parts of Germany, is equal to the best Oriental china.

† It is probable that the heaviest and most compact china will always prove to be the most durable. Dr. Watson, in taking the specific gravity of several specimens of pottery, found that a cubic foot of cream-coloured ware weighed 1988 ounces avoirdupois; of flint ware, 2188 ounces; of Bristol stone ware, 2340 ounces; and of the East Indian china, 2346 ounces.

‡ In the year 1803, Professor Proust, of Madrid, published some remarks on the glazes of pottery. See his paper in the *Journal de Physique*, under the title of "A Memoir on tinning Copper Vessels." Extracts from this production will be found in the *Philosophical Magazine*, vol. xxi. p. 313.

§ The fusibility of the earthy compounds depends upon their proportions. Lime and clay are, separately, infusible; but, in due proportions, the mixture is capable of forming a perfect glass.

expense, there is porcelain manufactured in some parts of this kingdom, which is more durable than that commonly made in the Staffordshire potteries. Such was formerly the Bow china, and that also made at Chelsea; and I have been credibly informed, the china now manufactured at Worcester is nearly equal to the best Dresden, or to the true Nankin, in all those properties which give the most value to this production of art.

It is worthy of observation, that while the king of Prussia was pursuing every possible method of advancing and extending the manufactory at Berlin,* the works at Worcester continued to improve year after year, without patronage, and that they were brought to their present perfection solely by the genius and enterprise of the proprietors.

Of late years, a porcelain manufactory of considerable consequence has been established at Coalport, in the county of Salop. Some peculiar kinds of china, both serviceable and beautiful, are produced at these works.

The common heat of the potter's kiln in England is about 60° of Wedgwood's pyrometer,† which is equal to 8877 degrees of Fahrenheit, for the cheapest cream-coloured ware, and about 80° of Wedgwood for the Staffordshire porcelain; though I have reason to believe that the manufacturers of the best cream-coloured ware, seldom allow the heat of the kiln to exceed 45° of Wedgwood's pyrometer. It must be recollected, however, that we fire twice, and that these heats refer to what are employed in converting the ware into what is called biscuit.

I am not myself acquainted with the respective temperatures at which the other porcelain manufacturers fire their ware; but Dr. Henry has stated, that the Worcester china vitrifies at 94, that the Chelsea porcelain is fired at 105, and the Derby at 112 of Wedgwood.

In the Staffordshire potteries the temperature of the gloss-oven is generally about 10° of Wedgwood, or 2377 degrees less of Fahrenheit than the heat of the biscuit oven. The reason of this is, that there may never be any danger of the ware, in this last operation, undergoing a higher degree of heat than it experienced in the first burning; it being absolutely necessary for the operator to be careful of this point, because, as clay will continue to contract by every addition of heat, it must follow, that should it ever be pushed beyond that degree which it sustained in the state of biscuit, the body of the ware would experience a greater contraction, and consequently every piece within the oven would either become crooked, or the glaze would be injured. The firing of the gloss-oven generally requires from 12 to 14 hours.

* In order to encourage this manufactory, and make its productions more generally known, the king made presents of complete services of the Dresden porcelain to all the sovereign princes in Germany.

† For an account of the construction of Wedgwood's pyrometer, the reader is referred to the 72d and several of the subsequent volumes of the *Philosophical Transactions*, or to Murray's *System of Chemistry*, vol. i. p. 150.

The glazing for the common cream-coloured earthenware consists usually of certain portions of litharge and ground flints, mixed with as much water as will form them to the consistence of thin cream, which is found to be a state the most suitable for the immersion of the ware. One hundred pounds of litharge, and 40 pounds of ground flints, are the common proportions; but it is usual to take 80 pounds of Cornish granite to 100 pounds of litharge, whenever that is used instead of flints. Flint is the article which is employed in making glaze for the porcelain, as well as for the coarse earthenware, it being nearly all silica. Klaproth found common flint to consist of ignited silica 98 parts, lime 0.50, alumina 0.25, ignited oxide of iron 0.25 parts, volatile in the fire 1.

For the finer kinds of earthenware, and for porcelain, it is made with white lead, ground flint glass, ground silica, and common salt. Some manufacturers, however, add other materials; most of those who superintend this department imagining that they possess a valuable secret, and that in consequence of it their glaze is much better or cheaper than that of others.

In all manufactories it is found necessary to vary the composition of the glaze, according to the nature of the materials which form the body of the ware; and the former cannot be perfect unless it be capable of contracting and expanding by heat and cold, in the same proportion as the ware itself will contract or expand by the change of temperature. The writer of the article *Porcelain* in the French Chemical Dictionary very properly remarks that "a glass which makes a fine glazing for one porcelain will make a very bad glazing for another sort of porcelain, will crack in many places, and have no lustre. The glazing must be appropriated to the density of the ware and the ingredients of its composition."

[TO BE CONTINUED.]

NATURAL HISTORY.

THE BEAVER.

(Concluded.)

*Fabulous History of the Beaver.**

THIS part of our subject is richer in materials than any other which comes within the scope of our work. We have in the beginning adverted to the grand source of error in this and other departments of natural history, but there is one circumstance peculiar to the history of the beaver, which has thrown over it more delusion than in the case of almost any other animal. The fur traders, Indian

* We have selected, from Dr. Godman's Natural History, about one third part of this division of the subject, as the whole would have demanded more space than we could afford. Those who wish to see more of the *poetry* of Natural History, are referred to the original work. [EDITOR.

interpreters, and Indians themselves, have furnished the greater part of the information which we possess of the habits and manners of this animal. To these persons the beaver is a most important object, and regarded with a degree of admiration and superstition exactly proportioned to their ignorance. Hence they have in numerous instances been led to magnify facts actually observed, and to state their own notions of the sagacity of the animal, as realities, not intending to deceive, although they have deceived themselves. To become acquainted with the peculiarities of a species both nocturnal and exceedingly timid and vigilant, requires years of patient and assiduous attention. It is not surprising, therefore, that persons seeking information should resort to those who are devoted to the pursuit of the animal, and receive their statements, given with seriousness and minute detail, as worthy of credit. In addition to the errors which spring from the ignorance of these observers, there is a worse evil to which inquirers are exposed. The traders, hunters, and interpreters have, for various reasons, considerable jealousy of all those who are too inquisitive about their peculiar concerns, and it is an occurrence of almost daily repetition, that when they are questioned on these subjects, they take a malicious pleasure in palming, with truly Indian gravity and patience, the most false and marvellous relations upon their auditor.

As the reader is already in possession of all the well-attested facts to be procured in illustration of its habits and character, we may safely present a few of the marvellous relations which have been heretofore given of the beaver, leaving him to separate the great mass of fiction from the few truths with which they may be mingled. We therefore begin with the most ancient of these fictions, and come down to the latest writers who have contributed to the perpetuation of such erroneous views.

"The castor, or beaver, when in the rivers, feeds upon shell-fish and such other prey as it can catch. This variety of food is the reason why its hinder parts, to the ribs, have the taste of fish, and that they are eaten upon fast days, and all the rest has the taste of flesh, so that it is not used at other times.

"It has pretty large teeth; the under, standing out beyond their lips, about three fingers breadth; the upper, about half a finger, being very broad, crooked, strong and sharp, growing double, very deep in their mouths, bending circular, like the edge of an axe, and are of a yellowish red. They take fishes upon them as if they were hooks, being able to break in pieces the hardest bones. When he bites he never loses his hold until his teeth meet together. The bristles about their mouths are as hard as horns; their bones are solid and without marrow; their fore feet are like a dog's, and their hinder, like a swan's. Their tail is covered over with scales, being, like a soal, about six inches broad and ten inches long, which he uses as a rudder to steer with, when he swims to catch fish; and though his teeth are so terrible, yet when men have seized his tail they can govern the animal as they please.

"The beavers make themselves houses of square timber, which they gnaw down with their teeth, almost as even as if they were sawed, and almost as equal as if it were measured. They lay these pieces across, and each is let down by large notches into the other, so that, having dug a hole for their foundation, they build several stories, that they may rise higher or lower, according to the fall of water."*

"Amongst the beavers some are accounted masters, some servants. They are cleanly in their houses; for the making of which, they draw the timber on the belly of their ancients, they lying on their backs."†

"They have a chief or superintendent in their works, who directs the whole. The utmost attention is paid to him by the whole community. Every individual has his task allotted, which they undertake with the utmost alacrity. The overseer gives a signal, by a certain number of smart slaps with his tail, expressive of his orders. The moment the artificers hear it they hasten to the place thus pointed out, and perform the allotted labour, whether it is to carry wood, or draw the clay, or repair any accidental breach. They have also their sentinels, who, by the same kind of signal, give notice of any apprehended danger. They are said to have a sort of slavish beaver among them (analagous to the drone) which they employ in servile works and domestic drudgery."‡

"Sometimes a single beaver lives by itself, and is then called a *hermit* or *terrier*. Whatever may have been the cause which has separated these individuals from society, it is certain that they always have a black mark on the inside of the skin upon their backs, which is called a saddle, and distinguishes them from the others. Cartwright supposes this separation from society may arise from their fidelity and constancy to each other, and that, having by some accident lost their mate, they will not readily pair again. He thinks, likewise, that the mark on the back may proceed from the want of a companion to keep that part warm."‖

"Three beavers were seen cutting down a large cotton-wood tree: when they had made considerable progress one of them retired to a short distance and took his station in the water, looking steadfastly at the top of the tree. As soon as he perceived the top of the tree begin to move towards its fall, he gave notice of the danger to his companions, who were still at work, gnawing at its base, by slapping his tail upon the surface of the water, and they immediately ran from the tree out of harm's way."§

"The Indians have related to me, in a positive manner, another trait of these animals, but it is so extraordinary that I leave you at liberty

* Pomet, Hist. of Drugs.

† Lemery.

‡ Pennant's Arctic Zoology, p. 117. vol. i.

‖ Church, Cab. Quad. Bachelors of the human species have good cause to rejoice that their backs are clothed, if Captain Cartwright's doctrine holds good throughout, otherwise their forlorn condition would be at once indicated by something like the aforesaid *saddle*.

§ Long's Expedition to the Rocky Mountains, vol. i. p. 464. It is but just

to believe or reject it. They assert, and there are some who profess to have been ocular witnesses, that the two chiefs of two belligerent tribes, sometimes terminate the quarrel by single combat, in the presence of the two hostile armies, like the people of *Mediève*, or three against three, like the Horatii and Curiatii of antiquity. Beavers marry, and death alone separates them. They punish infidelity in the females severely, even with death.

"In fine, these animals are so extraordinary, even in the eyes of the Indians themselves, that they suppose them men, become beavers by transmigration, and they think in killing them to do them a great service, for they say they restore them to their original state."*

We may advantageously conclude the fabulous history of the beaver, by introducing the judicious observations made on the subject by Hearne, whose excellent remarks on this animal have been, hitherto, altogether overlooked.

"I cannot refrain from smiling when I read the accounts of different authors who have written on the economy of these animals, as there seems to be a contest between them who shall most exceed in fiction. But the compiler of the Wonders of Nature and Art, seems in my opinion to have succeeded best in this respect, as he has not only collected all the fictions into which other writers on this subject have run, but has so greatly improved on them, that little remains to be added to his account of the beaver, besides a vocabulary of their language, a code of their laws, and a sketch of their religion, to make it the most complete natural history of that animal which can possibly be offered to the public.

"There cannot be a greater imposition, or indeed a grosser insult on common understanding, than the wish to make us believe the stories of some of the works ascribed to the beaver; and though it is not to be supposed that the compiler of a general work can be intimately acquainted with every subject of which it may be necessary to treat, yet a very moderate share of understanding would be sufficient to guard him against giving credit to such marvellous tales, however smoothly they may be told, or however boldly they may be asserted, by the romancing traveller."†

Description of the Beaver.

The beaver is about two feet in length, having a thick and heavy body, especially at its hinder part. The head is compressed and somewhat arched at the front, the upper part being rather narrow, and the snout, at the extremity, quite so; the neck is very short and thick. The eyes are situated rather high up on the head, and have rounded pupils; the ears are short, elliptical, and almost entirely concealed by the fur. The whole skin is covered with two sorts of hair; one which is long, rather stiff, elastic, and of a gray colour for

to state that this is given, in that work, as a "*hunter's story*," which is too often synonymous with an English word of three letters.

* Beltrami; La Decouverte des Sources du Mississippi, &c. 1823.

† Octavo ed. 1796, p. 231.

two-thirds of its length next the base, and terminated by shining, reddish, brown points, giving the general colour to the pelage; the other is short, very fine, thick, tufted and soft, being of different shades of silver gray or light lead colour. On the head and feet the hair is shorter than elsewhere. The tail, which is ten or eleven inches long, is covered with hair similar to that of the back, for about one-third of its length nearest the base, the rest of it is covered by hexagonal scales, which are not imbricated.

The only species of beaver, known, is the one we have described; all the others which have been noticed, are varieties of this species.

During the first year of their lives, the beavers are termed pappooses, by the hunters; when two years old, small meddlers; at three years of age, large meddlers; in their fourth year they are called beavers, and after that, old, or great beavers.

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. V.—*Processes followed in Bleaching.*

SECTION II.

2. *Bucking.*—This is one of the processes which has lately received important improvements from the invention of an apparatus called the whale boiler, whose operation has already been described. But whether this be used, (and it is not yet general,) or the old apparatus, the goods are treated precisely in the same way, and it is a very important part of the whole operations. The first thing to be attended to in bucking is the preparation of an alkaline ley of a proper strength. For this purpose the crude alkali is to be broken into small pieces not exceeding the bigness of a hazel nut, or bruised by means of a horse mill, and put into the boiler with a proper quantity of water. It would be an economizing of fuel to put this into the boiler immediately on drawing off old leys, when the heat of the boiler and its fire place, supposing a small quantity of the fire to remain, the registers of the furnace being shut up and the boiler covered, will be sufficient to melt the alkali in the course of the night. The liquor ought not to be permitted to boil, for Dr. Home, (p. 103,) proves by experiment that salts from ashes by boiling are not so strongly alkaline as the ashes themselves. If pearl ashes are added to a ley made from the other crude alkalies, they need not be put in till the solution is nearly completed, as their greater quantity of carbonic acid renders them much easier to dissolve. Those who pursue the older modes of bleaching, put the goods into the alkaline solution which is thus prepared; but as its strength can be, according to Kirwan's experiments, increased one-half by the addition of so cheap an article as quick-lime, this ought never to be neglected, particularly also as chemistry informs us, that no alkali will combine with any oleaginous matter (unless it be in a state of causticity). It

is of great importance to attend to this when American pearl ash is used, as it always contains a large proportion of carbonic acid. Des Charmes advises to take of quick-lime the whitest which can be had, a third or a fourth part in weight of the solution, and heat up in a bag or cloth to prevent it from rendering the ley turbid. A better method is to add one part of well-burned fresh-slaked and finely pulverized quick-lime, to two parts of the alkali dissolved as above. When the lime has been added, the mixture is to be brought to boil, taking care to keep it in constant agitation with an iron rake, to prevent the lime from subsiding, and fixing on the bottom of the boiler. When the ebullition has commenced, it will produce sufficient agitation to keep the lime suspended. The boiling may be continued for two hours, when the lime may be allowed to subside and the clear supernatant liquor, now in a state of causticity from the loss of its carbonic acid, may be run off for use. The lime which has subsided is to be washed with water till it comes off clear without alkaline taste, and the washings are to be kept for making fresh leys. The bleachers ignorant of chemistry, erroneously imagine that the lime imparts some of its properties to the ley, but as the precipitated lime is found to be a carbonate, it clearly appears that it has by superior affinity abstracted the acid from the carbonated alkali. Des Charmes says that it is not necessary to add lime to American and Russian ashes, as they contain a large proportion of it when imported, but he surely forgot that this lime is commonly in the state of a carbonate, and therefore cannot take up the carbonic acid which renders the ashes mild.

I have stated, that in rendering alkalies, caustic quick-lime is to be added in the proportion of two to one by weight, but this is somewhat vague, and will not apply where there is much difference of quality in the alkalies. It will consequently be of importance to ascertain some test by which to determine when a proper quantity of lime has been used. For this purpose, when the boiling of the mixture has been stopped, take a little of the supernatant liquor in a wine glass, and breathe into it through a small glass tube, or add to it a few drops of clear solution of subcarbonate of pot-ash; if there be a redundancy of lime, the dissolved earth will absorb the carbonic acid from the human breath, or from the pot-ash, and will render the liquor turbid. If it does not become turbid, add a little lime-water, and if this occasions turbidness, it shows, that the liquor contained carbonated alkali, and has not had a sufficient quantity of lime. If the lime be in due proportion, the ley will neither show turbidness from these tests nor will it effervesce with acids.

It is of the greatest importance to the bleacher to be able to determine readily, the specific gravity of his leys, as they must be used as nearly as possible, of the usual strength: ley of 1.0127, or 1.0156 specific gravity is what is commonly employed. To ascertain this, the hydrometer is generally used. A new instrument of this sort was, some time ago, proposed by Professor Leslie, (Ph. Mag. XVI. 200,) but I have not heard whether it has ever come into use. It was to be constructed on the principle which he has fully demon-

strated—that capillary attraction is nothing more than the specific relative attraction of solids and fluids, and the purity of the liquid examined, would be indicated by its ascent in a capillary tube graduated with enamel colours. The instrument in common use is not so simple, nor so elegant. Those which were formerly employed were not constructed on a fixed principle, so that when one of them was broken, another could not be made to the same scale. This inconvenience, however, has been removed by the ingenuity of Mr. Tweedale of Glasgow, whose hydrometers are now universally used. The method which he adopts is to commence the scale at 1, and to make every degree indicate .005 of specific gravity. Hence, supposing the alkaline ley to indicate 20° on the scale, its specific gravity would be $1.+20\times.005=1.100$, the specific gravity of water being unity. A complete series of these numbers from 1 to 6, indicates the specific gravity of fluids; from distilled water, as 0. to sulphuric acid, 2. the heaviest liquid known. In using such instruments it is necessary to attend to the temperature of the atmosphere, as all bodies are greatly influenced by their sensible caloric, and their bulk increased or diminished according to the quantity which they contain. In water, the fifth decimal figure changes with every degree of Fahrenheit's thermometer, other fluids observe different rates. Some bleachers guess at the strength of their leys by the taste, but this must, at best, be an uncertain criterion. Des Charmes tells us that the laundresses of France ascertain the quality of leys from their lubricity when rubbed between the finger and thumb, or from the readiness with which they absorb the colouring matter of the goods.

When leys are made caustic by means of quick-lime, and drawn off for use, they will commonly be of the same strength at the top and bottom of the vessel; but when they are not removed from the boiler, and the goods are put in as soon as the solution has been effected, the liquor will be often three-fourths stronger at the bottom, than at the top, from the undissolved alkali continuing to melt. This ought to be carefully attended to, as it is contrary to the general law which obtains in solutions, namely, that they are of equal strength throughout. Dr. Home supposes the anomaly to depend on the presence of lime in a state of mechanical mixture.

It is of importance that the ley should be always as clear and limpid as possible, for if the lime remain either in solution or suspension in the smallest proportion, it is apt to be precipitated into the fabric of the cloth, and will be fixed by the sulphuric acid sour, which will produce an insoluble selenite. This, however, is not of so much consequence for the two or three first immersions, as it is when the goods have once acquired an even colour, and require only to be brightened. It is then essential for the saving of time and labour, to have them as colourless as possible.

Des Charmes directs the goods to be put into the bucking apparatus in a moist state; Dr. Home, that they should be dry, in order, he says, "that the salts may enter into the body of the cloth, along with the water, as they will not enter in such quantity if it be wet,

and by acting too powerfully on the external threads may endanger them." The Doctor's reasoning appears to me perfectly just.

The goods which have been treated as already directed, are placed in the kieve in open folds, as in the steeping process, and a quantity of the caustic ley (heated to the temperature of the blood), is poured over them, sufficient for their thorough immersion. The heat is increased, very gradually, till it reach the boiling point, when it is thrown up against the umbrella, and spread, by it, over the surface of the goods, through which it percolates into the boiler again, and so on in succession till it be saturated with impurities. This is known from its losing its causticity, and acquiring an offensive smell, or from the deepness of the colour both of the ley and the cloth. The success of the process indeed is commonly estimated in proportion to the deepness of the colour, which the cloth has acquired. (Home, p. 72.) Particular attention ought to be given to the gradual increase of temperature now directed. For the resinous or oleaginous colouring matter of the cloth, the twisting of the threads, and closeness of texture, must hinder the liquid from penetrating it, particularly at first, so that if the ley were poured on at 212° the cloth might be liable in several parts to a dry heat. This is usually illustrated by the general effects which heat produces on coloured vegetable matter. Thus if any vegetable is to be softened, or to have its juices extracted, it is found that this can be better done by beginning with moderate degrees of heat, than by plunging it all at once in boiling water, which would rather harden it and fix its colours. Cooks are well aware of this, and always when they wish to preserve the green colour of vegetables after boiling, never put them in till the water has acquired its highest temperature. The same reasoning applies to the process of bucking: and here also it is confirmed by experience, as goods which have unfortunately been put into boiling ley in the first instance, can never be brought to a good white. Dr. Home is so much impressed with the importance of this, that he deems it adviseable to keep the ley under the boiling point for the two first buckings; but this is surely carrying the precaution too far.

Des Charmes' method excluded boiling as unnecessary, it being sufficient, he thinks, that the ley be hot and sufficiently abundant. He takes out his goods when the liquid under the cover in the middle of the heap is too hot to admit of the hand being held in it, or when it simmers round the circumference of the boiler, and throws up white bubbles, which circulate towards the centre. Frequently he only plunged the goods, for a few minutes, into ley of a very gentle heat, and he found that by this treatment, both cotton and piece goods, bleached perfectly well.

The leys, when the above circumstances are indicated, are to be drawn off, and warm water poured over the cloth in the kieve, which by combining with part of the remaining impurities which have been loosened, serves to carry them off. When this has been done, a stream of cold water is allowed to play on the goods till it run off nearly limpid, after which they are taken to the dash wheel; the reason for this process, which is not always properly attended to,

is, that were the cloth carried from the kieve to the dash wheel, while hot, a certain portion of the colouring matter would be again fixed in it, which would not easily be again removed.

The process of bucking is successively repeated, even as often as 10 times, before the operations are finished, and with leys of different strength. I find that with respect to the variation of the strength of the leys, there are two modes recommended, directly opposed to one another. Des Charmes says it is adviseable to keep the leys at the same degree of force, during the first two or three immersions of the same goods, *diminishing the strength one third or one fourth*, as soon as the pieces have acquired a uniform colour. In this period, weaker leys may be advantageously used, because there remains scarcely any thing more of impurity to be carried off; and the subsequent process may be considered merely as a brightening of the colour by detaching the small portion of impurity which may remain fixed in the texture of the thread, (p. 81.) With this, agree the experiments of Mr. Roe and of Bings, (Report on Experiments, &c. Dublin, 1791.) The practice of our bleachers in Scotland and Ireland is directly the reverse of this. They use the weakest leys at the commencement, and increase them in strength as they proceed. Dr. Home's reasoning on this seems to be conclusive. "The leys," he says, "should be weakest in the first buckings, because then they act only on the more external parts, but when the cloth is more opened, and the field of action increased, the chemical agent ought likewise to be invigorated," (p. 61—2.) This argument, and the uniform practice of our most enlightened bleachers, should, I think, clearly determine this point.

In repeating the bucking process, most bleachers occasionally use leys which have formerly been used for a similar purpose, even more than once. This practice we have already reprobated, when treating of steeping, and in the present case it is of no less importance to avoid it, particularly in bucking fine goods. They seem to have been led to this bad practice from its apparent economy, but when it is considered that it is only the unsaturated portion which can act, pure ley must evidently be cheaper. Besides, cloth bucked with foul ley, becomes heavier instead of lighter, and consequently must receive impurity from it. Des Charmes directs a mixture to be made of foul with new ley, adding a third or fourth of the latter; but these added portions of fresh ley must be greatly impaired in strength, by taking up the impurities with which the old ley is loaded, and this is found to agree with experience. It is of some consequence to remark, that little advantage can arise from several buckings, *immediately* succeeding one another: even the second immersion in the ley will frequently leave it quite limpid. Des Charmes found it of more advantage to use the ley rendered caustic by lime at the commencement of the buckings than afterwards, when it might impair the texture of the goods.

SECTION III.

3. *Washing.*—It is never to be forgotten, that between each of the several processes, of steeping, bucking, souring, &c., the goods are to be thoroughly washed by the dash wheel in pure water, so that all the loosened impurities, as well as the detergent which has been employed, may be effectually removed. When any of these are left through defect of washing, they not only prevent the proper operation of the agents afterwards supplied, but often leave in the cloth indelible stains. Besides, as it may, through neglect, become dry after bucking or souring, the salts will be condensed in proportion to the dryness of the cloth, and acting with greater force will destroy its texture. Soap is not employed except in the first washings and in finishing. Black, or soft soap is found to be the best for these purposes, brown soap leaving a yellowish tinge on the cloth. If these precautions are not attended to, the goods which are imperfectly washed will be in danger of becoming yellow instead of white, by immersion in preparations of chlorine; and even of acquiring a tenacious and disagreeably ruddy tinge, either partially, if the washing has been partial, or totally, if it has been entirely neglected. The bleacher should be on his guard, not to soap cleared goods in the soapy solution which has been used for pieces taken out of a strong chlorine preparation, even though they have first passed through a sour of sulphuric acid; for this soapy solution does not fail to acquire the property of discolouring other goods, unless the goods which were soaped, after being taken out from the chlorine preparation, have been immersed for a long time in clear water. Washing should always if possible be performed *immediately* after bucking, while the goods are yet warm, as the filth and refuse will then be easier removed than after they become cold.

4. *Crofting, or exposure on the Field.*—It has been accounted a great desideratum in bleaching to find a method of finishing goods without exposing them on the bleach-green, as it consumes a great deal of time and labour, and keeps out of cultivation large tracts of good arable land. It was thought, at one time, that the introduction of chlorine bleaching, would supersede crofting; and it would do so, in a great measure, were it practicable to apply it in a proper manner. But, however great may be its facility in bleaching, it is scarcely possible to adopt it in an extensive manufactory to the exclusion of crofting, without very heavy charges in work-shops and apparatus. This naturally follows from what has already been remarked with regard to finishing the bucking process; and it is useful to take notice of it, as bleachers often let their goods lie in heaps for a considerable time before washing. The washing of goods after souring, is sometimes admitted on the erroneous notion that the acid which adheres to the cloth, is useful in giving activity to the oxymuriatic salts. Evils of which they are unaware, arise from this mode of management; for when the sulphuric acid thus left in the cloth, meets with lime, it forms a sulphate, which becomes fixed in the pores of the cloth, and produces stains that crofting cannot remove.

The prevalence of this may be seen by examining the kiers which are often covered on the inside with this pernicious sulphate; it can therefore only be economically adopted with such goods as are intended to receive what is called a half, or three-quarter white. It has certainly very much diminished the period which crofting was wont to require, and in this seems to consist the chief difference between the old and the new modes of bleaching.

The first thing which claims attention, is the soil and situation of the bleach-green. A gravelly or sandy soil seems to be the best, as the water will pass quickly through a soil of this kind, and will increase the reflection of the heat, for the process depends on the evaporation which may thus be caused. For the same reason it ought to have a southern exposure, and if possible should rather be sloping than level. To prevent the water becoming muddy it should run in a channel paved with sand-stone.

When the cloth has been steeped and bucked, it is spread out on the field, and frequently watered for the first six hours, to prevent the condensation of any alkali which the washing may not have removed. Dry spots are then allowed to appear before any additional watering. Dr. Home thinks that it profits most by this exposure when near drying, as the evaporating particles come rather from the more internal parts, than the surface; and that it is chiefly evaporation which operates, is inferred from the fact, that the upper, is uniformly whiter than the under surface. That it loses together with its grayish tinge the remainder of the acids and alkalies, with which it has been treated, appears from the safety with which it may be afterwards dried. Soap when sliced down and exposed to the sun and air, with frequent waterings, will lose half its weight in a fortnight; the inference is obvious and need not be stated. From some experiments it appears that the sulphur of the leys is one of the substances which is evaporated in crofting, and we know that this always has a tendency to produce a yellow tinge. (See Trans. R. T. Acad. III. p. 45.) Berthollet seems to have taken a view of this process not quite so scientific as might have been expected, when he tells us (Ann. de Chim. II.) that crofting only prepares the colouring particles for being afterwards dissolved and separated by the ley. He surely never had observed the peasants bleach, by crofting alone, or by crofting *after* boiling in alkaline or soap leys.

It is supposed by bleachers, that exposure on the field has more effect in the months of March, April, and May, than in any of the other months. As this idea is universal, it is likely well-founded, although Dr. Home has endeavoured to account for it by the greater attention which is usually paid to goods at the beginning of the bleaching season. He states also that Mr. Christie, an experienced and enlightened bleacher, found the summer and autumnal months to be more efficacious than those of spring. But may not the drought prevalent in March, produce such an effect, if evaporation is the agent? And if light, as seems indubitable, is requisite, will not the want of clouds at this time be of consequence? The effect of light on colours is often very striking. When I was in Ireland, I observed

that the bed curtains in the rooms of Shane's castle, which are exposed to the reflection of light from loch Neagh, were changed from fast and brilliant colours, to pure white. Baume (Journ. de Physique 1793) found that yellow raw silk, loses its colour in a short time, by exposure to the sun, (see a memoir on this subject, Ann. de Chim. VI. 80.) Berthollet imagined that there might be something in dew, which was efficacious in crofting, and he accordingly examined the dews which fell at different periods of the night. He found them (Ann. de Chim. II.) so strongly impregnated with the principle of acidity, that they reddened paper tinged with turnsole. From this he accounts for the greater efficiency of spring dews, on the erroneous doctrines that dew is transpired from plants, and that plants transpire oxygen and dew most copiously in spring. That the sun has a considerable effect in whitening, independent of evaporation, appears from this, that in dry windy weather the evaporation is more speedy, but the bleaching is slower than in calm sunshine, which seems to be the best weather for crofting. Dr. Home thinks however that in consequence of the slowness of the evaporation, the moisture comes more from the internal parts of the goods; this he thinks must be the case, in consequence of the heat tending to open the pores, while the wind will rather close them. The same intelligent chemist remarks, that it is in consequence of its completing the bucking process, by evaporating the salts which are combined with the loosening impurities, that crofting proves beneficial; no sort of washing which he tried as a substitute, was found capable of superseding the process; crofting always follows every bucking and boiling. There are, strictly speaking, two modes of crofting: the goods are artificially watered from troughs or little canals; or, they are exposed to all the vicissitudes of the atmosphere, without artificial watering. The latter is called dry crofting.

5. *Boiling.*—Coarse linen cannot afford the time and labour, but particularly the quantities of alkali, necessary for bucking, and must undergo the shorter and more active operation of boiling. Although, however, it may seem to be the more active process, it by no means follows that it is the most efficacious; on the contrary, the ley is much thicker and darker after bucking, than after boiling. As the heat continues longer at the degree of boiling, the leys used for the coarse cloth must be weaker than those used for the fine. There is not so much danger from heat in the coarse as in the fine cloth, because the former is of a more open texture and will allow the ley to penetrate more speedily; but in coarse cloths of a more close texture, the heat should be raised gradually to the boiling point. The effect of boiling raw cotton or linen in a diluted solution of caustic alkali, is to give the liquor a deep brown colour and to destroy its causticity; and fresh portions of clear ley applied a second or third time will produce similar effects, but in an inferior degree. (Rees' Cycl. Bleaching.)

In bleaching fine goods, boiling is among the finishing operations, and is only employed when the goods are nearly white, in order to remove the disagreeable smell of the preparations. The ley in this

case is composed of pearl ashes, or of pearl ashes and white soap. The boiling ought not to be urged with a brisk fire, but kept barely at the boiling point. The goods must be completely covered with the ley, and kept from rising by a cross similar to that used in steeping, in order that they may be exposed equally to the action of the alkali or soap. In bleaching fine cottons, such as lawn grounds, books, and light jaconets, no pearl ashes are used, the ley being made wholly of soap.

6. *Immersion in the preparations of Chlorine.*—When the oxymuriates of lime, potash, soda, or magnesia have been prepared in the way already directed, they are to be diluted to the specific gravity of 1005, or 6 or 8 quarts of the solutions may be mixed with 20 gallons of water, and put into the immersing apparatus of Rupp or any other which may be thought best. The test liquors already so fully described are then to be had recourse to, to check the indication of the specific gravity. Mr. Dalton's certainly seems to be the best, but where this is not at hand, solutions of indigo, cochineal, or turnsole, may be used; even red wine is no despicable test, when the others cannot be had. It may be useful to take notice of the several colours which these test liquors acquire when the chlorine preparations are of sufficient strength. Dalton's tests have already been copiously explained. The indigo test becomes yellowish, passing into wood, and of a deeper or fainter tint, in proportion to the darkness of the blues; the tincture of cochineal, becomes Dutch orange; red-wine becomes wine yellow; and infusion of turnsole, becomes amber brown. The goods are to be immersed in the liquor immediately on being removed from the bleach-green, and particular care ought to be taken that they be all equally exposed to its action, otherwise stains and spots may be produced, which subsequent treatment may not be able to remove. Twelve hours is the usual period allotted for the immersion of linens; but less time will sometimes be sufficient. The bleaching liquors, according to Mr. Roe's experiments, may be repeatedly used without detriment, till their whole strength be exhausted. *(Dublin Report*, 1791.*)*

MR. PERKINS'S NEW STEAM ENGINE.

We are anxious to satisfy public curiosity, which has been considerably excited by what we have already published, on the subject of Mr. Perkins's new steam engine. The letter addressed to us by that gentleman, promised a specification with drawings, and enquiries have been repeatedly made, whether these had arrived: but as the enrolment of his last patent in England, which embraces his recent improvements, was not to take place until September, we apprehend that at least a month must yet elapse, before the expected papers arrive; we however publish, from the London journals, such information as they contain, and are particularly pleased with having it in our power to present some engravings which will suffice to give a

very clear idea of the general structure of the engine, but more especially of the manner in which his generator is arranged. The two next articles, with the accompanying figures, are copied from the "Register of Arts and Science," a work very ably edited by L. Hebert, engineer; a new series of which has just commenced, under the title of "Register of the Arts, and Journal of Patent Inventions."

Mr. Christopher Davy, the writer of the second article, has published another communication on the same subject, in No. 200 of the London "Mechanics' Magazine," with a drawing representing a very elegant arrangement of the parts of the engine; but as it does not afford any additional information with regard to its structure, its republication is unnecessary; we will, however, offer a few remarks upon the observations of the editor, which accompany Mr. Davy's communication.

Those persons who have attended to the subject, are aware that in the earlier efforts of Mr. Perkins, he used a generator which was a single vessel, of great strength, surrounded by the fuel, and kept constantly filled with water, by means of a forcing pump; this was so highly heated, that the portion of water which was expelled from it at every stroke of the engine, immediately flashed into steam. In the use of this generator, many difficulties were experienced, which it is unnecessary to recount; and it now appears that he has substituted a series of tubes, which, he believes, have obviated all these difficulties. The editor of the Mechanics' Magazine thus notices this subject. "The chief novelty for which Mr. P. formerly claimed credit, was the generation of steam from water, confined by mechanical pressure, within a strong cylinder, till it became so hot, that a drop of it, on being forcibly ejected, would instantly flash into steam. But now Mr. P. injects the water, while cold, into a series of small tubes enclosed within a furnace, and heated as much as possible; from which tubes it is transmitted, in the shape of steam, to the working cylinder. It would appear, therefore, that Mr. P. has now abandoned all hope of realizing a working engine on his original plan, and has betaken himself to a mode of construction, in which he has the misfortune to be preceded by several, not unsuccessful competitors. Eve's engine, and Babcock's, which was successfully applied in America, to the propulsion of boats, about a year ago, are both like this of Mr. Perkins, on the tubular plan; so also are those of M'Kirdy and Gurney, which have been the subject of recent patents."

On reading the above quotation, any one might be inclined to believe that Mr. Perkins had abandoned his original idea of substituting pressure, for surface; or, in other words, of keeping his generator filled with water, at a temperature of several hundred degrees, by the aid of a powerful forcing pump, so that its free caloric should be sufficient to convert it into steam, instantaneously, when a portion of it was forced out. Several of our friends in this city, had drawn the conclusion that this abandonment had actually occurred; but, by a careful attention to the description of the action of the generator in its present form, they will perceive that the same principle still prevails. Tubular boilers, in various forms, have been repeatedly essayed, and that

long before the particular modifications, proposed by the gentlemen named, were presented to the public. The merits of the respective plans we are not disposed to discuss, but wish merely to point out the essential difference between the whole of them, and that of Mr. Perkins; which difference, it appears, has been frequently overlooked. We have said that his is kept filled with water; the others are heated, for the purpose of converting into steam, the water which is injected into them; in his, there is no steam, the others are filled with steam. The lower tier of tubes in Mr. Perkins's generator, may be considered as a part of his steam chamber.

From "The London Journal of Arts and Sciences," and from the "Technological Repository," we have taken the account of the first comparative trial of Mr. Perkins's engine, which appears highly favourable. The great and interesting question of its relative value, must soon be decided; and if but one half of the anticipations of the inventor are realized, his improvements will confer benefits upon the public, second only to those bestowed on the world by the immortal Watt.

We, in common with most of our friends, had been so long kept on tip-toe, looking for the fulfilment of promises repeatedly made, that we had nearly ceased to expect their performance; but "success is omnipotent," and should this equal the genius, and the perseverance of our countryman, we shall then be ready to express our surprise, at the obstacles which he has surmounted, and at the wonders which he has achieved, in the course of a few short years. May such be his triumph!

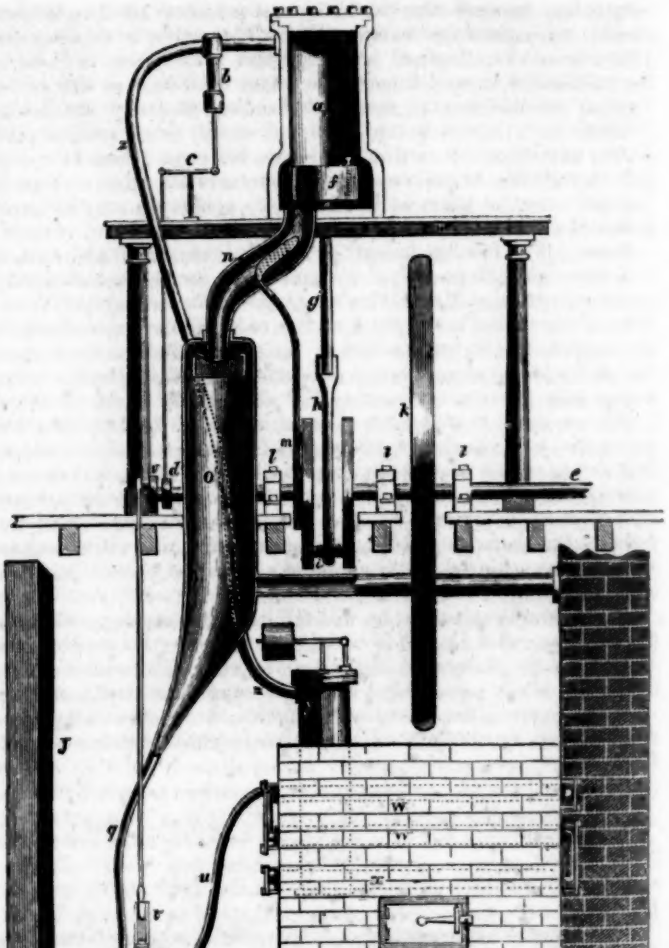
Should Mr. Perkins fail, he will fail in good company. Sir Humphrey Davy, and Dr. Wollaston, who occupy the most exalted stations in the temple of science, have countenanced his efforts, during his whole career; and with such support, it would argue no common degree of hardihood and temerity, to speak of his projects as chimerical, or even of a failure, as less honourable than a successful retreat.

A brief Description of Mr. Perkins's new "High Pressure Safety Engine."

To the Editor of the Register of the Arts and Sciences.

Sir,

Presuming that a brief description of Mr. Perkins's New "High Pressure Safety Engine," may, in the absence of a more amplified and particular account, be acceptable to your readers, I venture to send you the enclosed. It has been drawn up, perhaps, with too little regard to the arrangement and construction of the subordinate parts; but to have done full justice to the genius of the inventor in these respects, several drawings would have been necessary, and a more detailed description. I am anxious, therefore, that it should be clearly understood, that I only profess to give a correct account of the principle and mode of action of the engine, and with that intention the accompanying diagram, (see the ensuing engraving) is contrived to show the whole operation at one view.



Reference to the Engraving.—*a* is the working cylinder, supplied with steam by the valve *b;* this valve, by means of an intermediate lever *c*, is operated upon by the revolution of the cam *d*, on the main shaft *e*. *f* is the piston, *g* the piston rod, *h* the connecting rod to the crank *i; l l l* bearings in which the shaft turns; *m* is an eccentric, which works a valve placed in the injection tube, leading into the condenser *u;* the lower extremity of the condenser is formed into a box, having

two valves, opening outwards into the expansion vessel *o*, to which a pipe, *q*, is connected, leading into the hot well *p;* in this is placed a force-pump *t*, worked by a rod attached to the crank *v*, which forces the condensed water (temperature about 100°) through the pipe *u*, into the generators *w w*, fixed across the furnace, and through the opposite walls: *x* is a lower and third tier of pipes, similar to the others, but employed to allow the water from the former to expand into steam, after it has acquired sufficient power to overcome the pressure of a heavily loaded valve. From the pipes *x*, the steam passes into the large vertical chamber *y*, and from thence, at regular intervals, along the pipe *z*, into the working cylinder. The separate figure J, shows one of the pipes, of the generator, the same as those, at *w* and *x*, in perspective.

From the foregoing, it will have been noticed that this engine has only what is termed a single action, the steam being admitted on one side of the piston only; and that *the principle* of heating water in very strong vessels, under a high state of pressure, as in Mr. Perkins's former patent, is still adhered to. The pipes for heating the water, *w w*, and those for allowing it to expand into steam, *x*, are formed of cast iron bars, five inches square, with a perforation throughout their length, of 1¼ inch in diameter. These are arranged in three horizontal tiers over the furnace, in such manner that the heat shall act successively, and as uniformly as possible, upon their surfaces: they are connected at their extremities, so as to form one continuous vessel, by bent tubes screwed into their orifices, which are further secured by bolts and flanches, as represented in the diagram. The two uppermost rows are kept filled with water, at a very high temperature, under a heavily loaded valve, which communicates with the lowermost tier of tubes; into these the heated water is injected, (at every stroke of the pump) and instantly flashes into steam; the steam thus formed, has to pass, successively, through every pipe in the lowermost range, exposed to the strongest action of the fire; from the last of them it enters, by a short tube, the large vertical chamber *y*, for the supply of the engine.

The internal diameter of the principal portion of the cylinder is about eight inches,* but the lower end is enlarged into a cylindrical chamber of nine or ten inches in diameter, and about six inches deep, for the reception of the piston at the end of the stroke, which takes a range of about 20 inches. The steam is admitted into the top of the cylinder at a pressure of 800 lbs. upon the square inch, and when the piston has descended through one eighth of the length of the cylinder, the supply is cut off, so that the remainder of the stroke is effected solely by the expansion of the steam; when the piston has reached the bottom, or enlarged part of the cylinder, the steam rushes past it through the condenser into the expansion vessel, when the whole of it expands to the atmospheric pressure: the valves at the lower part of the condenser (before mentioned), now close by

* That at present on Mr. Perkins's premises in Water Lane, Fleet Street, which is at work, and open to public inspection every Saturday.

their own gravity, at which instant a spray of water is injected into the condenser, by which the remaining steam is condensed; and nearly a perfect vacuum effected. The water thus reproduced, is blown into the expansion vessel, along with the steam, at the next down-stroke of the piston; the water running down into the hot well, to be returned to the generators by the action of the force-pump, while the steam escapes by a lateral tube into the chimney of the furnace. The upward, or return, stroke of the piston, is effected by the momentum given to the fly-wheel; and to prevent any resistance to the ascent of the piston, which might be caused by condensed steam above it, there is a small valve in the piston, which is opened when the latter reaches the bottom of the cylinder; therefore, whatever uncondensed steam may remain in the cylinder above the piston, has free passage through the latter to the underside, thus occasioning no obstacle to its ascent. At the termination of the upward stroke of the piston, this little valve is closed, in like manner, by striking against the top of the cylinder, so that the next charge of steam introduced into the cylinder, may not be diminished in its effect.

The piston employed is of the metallic kind, and consists of several expanding rings, formed of a *peculiar alloy*, which Mr. Perkins states he has found to require neither oil, tallow, nor any lubricating material whatever, to reduce the friction; on the contrary, by the working of the engine, the rubbing surfaces of the piston and cylinder become so highly polished, as to reduce the friction considerably below that of the ordinary metallic packing when oiled. Thus Mr. Perkins has obviated one of the principal difficulties he had to contend with, namely, that of the oil or grease becoming carbonized, when working with steam of such high temperatures as he employs.

Among the advantages resulting from these novel arrangements, the ingenious patentee calculates that he saves full half the fuel usually employed; that by the mode of condensing the steam, he effects as perfect a vacuum as in Boulton and Watts's condensing engines, with a great saving in the consumption of water, and without the necessity of, or the friction attending, an air-pump.

Some exception has been taken to Mr. Perkins's mode of showing the power of his engine by a weighted lever resting on the upper edge of the periphery of his fly-wheel, a method involving so much uncertainty that I cannot believe it possible a man of Mr. Perkins's great talents can propose it as a correct test, but only as a convenient means of subjecting the engine to considerable labour by way of proving its power to a certain extent.

Your constant reader,

M. K.

[Since the foregoing was prepared for the press, we have been favoured with some excellent drawings of Mr. Perkins's New Engine and Generating Apparatus, made by Mr. Davy, from actual measurement; consequently embracing all the details in their true proportions, many of which are highly ingenious and interesting.

[*Editor of the Register of the Arts.*

A Description of Mr. Perkins's Engine; with Drawings, exhibiting its elevation, a section of the furnace and generators, and the structure of some other important parts. By Christopher Davy, *Teacher of Architectural Drawing, London.*

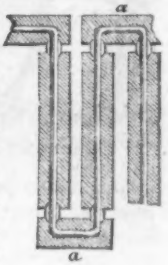
To the Editor.

Sir,

From the important nature of Mr. Perkins's improvements in steam apparatus, I feel assured that there needs no apology for bringing the subject of his "High-pressure safety Engine" again under the notice of your readers; and I cannot do better than preface this description by quoting the concluding remarks contained in the last lecture on the steam engine, delivered by the learned and worthy president of the London Mechanics' Institution.—"Important as many of these stupendous machines are, and great as have been our achievements through their agency, it must be confessed, that with respect to the nature of steam, the construction of steam engines, and their application to the service of man, we are, as yet, but on the threshold of our knowledge. * * * *—There is yet, I can confidently assure you, ample room for the exercise of your inventive powers."

Every candid person will, I think, freely admit that the great talents of Mr. Perkins, seconded as they are by uncommon energy and activity, have enabled him to make more rapid strides towards attaining those great benefits which Dr. Birkbeck has so eloquently described, than any other individual of the present day; for he has constructed an engine of unrivalled portability, and brought highly-elastic steam under perfect control; and, as a consequence, rendered it perfectly safe to employ its vast powers to any extent that may be deemed desirable.

I shall now proceed to describe the inclosed drawings,—and first refer the reader to fig. 2, which represents a longitudinal section of the furnace and steam generators. The latter consist of bars of cast iron 5 inches square, and lying horizontally in the furnace; each of these have a hole cast through them of $1\frac{1}{8}$ inch diameter, they also have communications with each other in the front and rear of the furnace, where they are so connected as to allow the water to be forced through each of the upper tiers, previously to its being flashed into steam in the lower tier. The connexions are formed, as shown by the diagram in the margin, which represents a sectional plan, exhibiting the before-mentioned connecting pipes, herein marked *a a;* these parts are entirely inclosed within the furnace, and are fastened by flanches on the outside, so that should the pipes become loosened, they may be fastened by the adjusting screws of the flanches, which draw them firmly into contact with each other, as I will presently more particularly describe. By the operation of a forcing pump, connected to, and worked by, the engine, the water is injected into the



ELEVATION OF PERKINS'S NEW "HIGH PRESSURE SAFETY ENGINE."

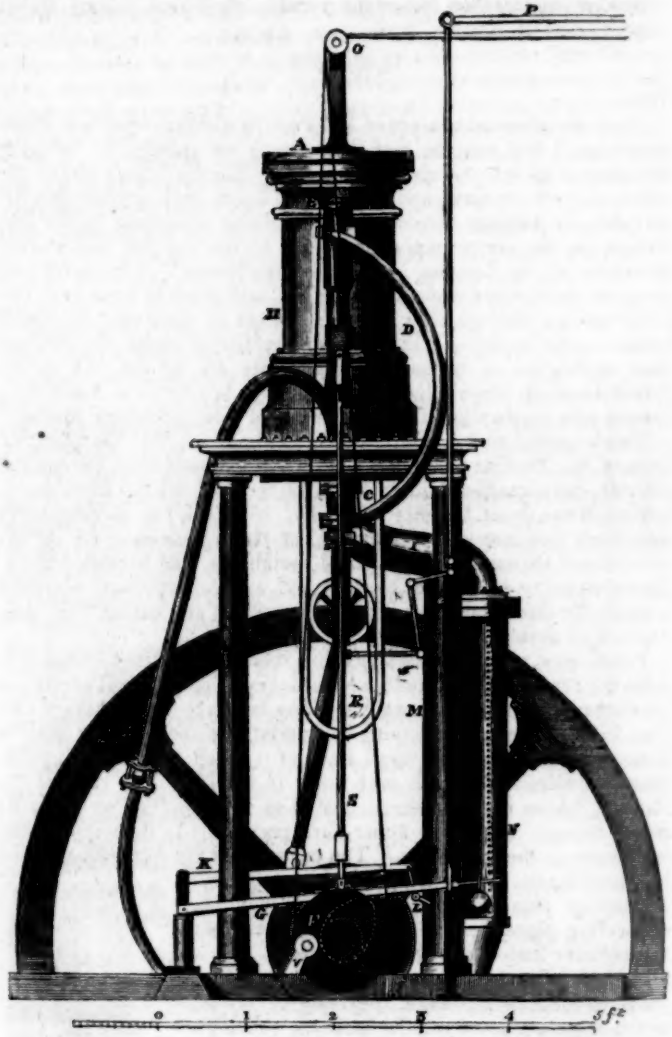
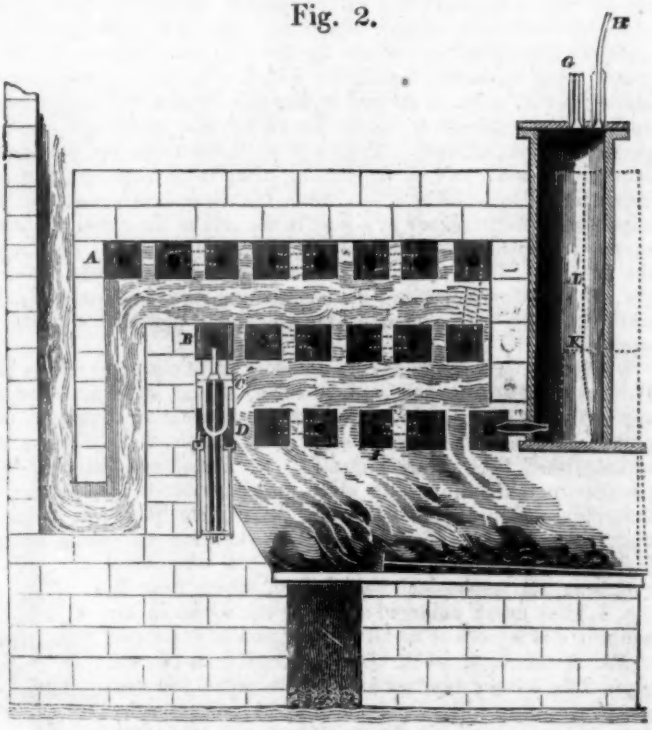


Fig. 1.

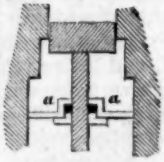
two upper tiers of tubes, marked A and B, (fig. 2,) wherein the water is raised, and kept up to a temperature of between 7 and 800° Fah. The lower tier, I, is kept at a heat of about 1000 Fah. so that at every stroke of the engine a certain quantity of water is displaced from the upper tiers, and discharged from the pipe B into the valve box C, which opening downwards is received into the lower tier of tubes, and instantly flashes into steam; from thence it rushes into the steam chamber L, and the valve C is replaced in its seat by the agency of a weighted lever; the notches F show the fulcrum of the same. G is a loaded valve, to relieve the pressure in the steam chamber, should it become overcharged with steam; H is the pipe which conveys the steam to the working cylinder, (the continuation of this pipe is shown at B, fig. 1); at K is an opening in front of the furnace, to supply the same with fuel.

Fig. 2.



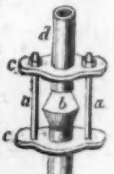
The steam being now generated at a pressure of 800 lbs. on the square inch, it passes through the pipe B, fig. 1, enters the pipe D at C, and from thence enters the working cylinder A at E. The steam has apparently no sooner entered the cylinder, than by the

action of the rod S, which is fixed to the lever G, and acted upon by the cam F, (dotted) it is shut off, the piston having then only performed one-eighth part of its stroke of 20 inches; the steam by its own expansion drives the piston downwards, and when at H, where

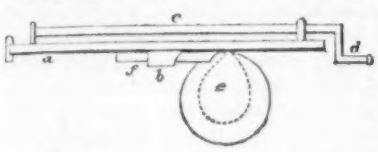


there is an enlargement of the cylinder, the steam is reduced to 100 lbs. upon the inch, occupies the space *a a*, and from thence is conveyed to the condenser I. The lower extremity of which, T, is furnished with a box, and two valves opening outwards, which valves close by their own weight, when the steam has expanded to the common atmospheric pressure: the lever K now performs its office, which being worked by a cam, the cock L is turned, by which movement a jet of water is thrown up the pipe N into the condenser I; and the steam therein is thereby converted into water, and nearly a perfect vacuum effected. The water from the valve box runs down into the hot well, and by the forcing pump is re-conducted into the upper tier of generating tubes, while the uncondensed steam in the expansive vessel escapes by a pipe in the side of the vessel *n*, at each successive stroke of the piston, and is conveyed off by the flue of the furnace. The momentum of the fly-wheel elevates the piston to the top of the cylinder, and the operation is repeated as already described. Such is the manner in which this powerful machine is worked.

I will now proceed to notice a few of those obstacles which Mr. Perkins has had to surmount, and which, at first sight, appeared insuperable. First, the carbonizing of the lubricating materials, employed to reduce the friction, such as oil, tallow, &c. This he has accomplished by availing himself of the important discovery of a peculiar metallic alloy, with which the piston has been constructed, that requires no grease whatever, the friction being less without, than with, the use of it. Secondly,—keeping the joints of the pipes steam-tight:—This is effected by a very novel and beautiful mechanical contrivance, shown near B, (fig. 1,) but on an enlarged scale by the figure in the margin; *b* is a piece of metal of the figure of two cones united at their bases, with their apexes inserted in the pipes *d d*; *c c* are flanches fixed to the pipes, and connected by regulating screws *a a*, which being turned draw the pipes *d d* firmly in contact with the intervening cone *b*. In this same manner the flanches of the furnace are made to tighten the transverse short connecting pipes already described. Thirdly,—Preventing any accident that might arise from the steam in the chamber L, fig. 2, becom-



ing surcharged with caloric.* Even since the short time that this engine has been constructed, two valuable improvements have been made by Mr. Perkins, proving, were it necessary, the accuracy of Dr. Birkbeck's remark, that in these machines there is yet ample room for the inventive powers of the ingenious. The first of these consists in a mode of shutting off the steam at $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{3}$, &c.



(as may be required,) of the stroke of the engine; it is accomplished thus, and is an improvement on the lever G in fig. 1. *a* is the lever, *b* a shoulder containing the wedge *f*, *c* an adjusting screw, to shift the wedge backwards or forwards. Now the cam, *e*, in its action will have to traverse round the hollow curved end of the wedge, and will consequently prolong the time of admission for the steam to the cylinder; *d* is a crank handle to adjust the screw and wedge *c* and *f*. The other improvement consists in reversing the motion of the fly wheel; a circumstance Mr. Perkins justly thinks invaluable, especially in whim engines for mines, and also for steam navigation. The cam F, fig. 1, is dotted, and supposed to show the situation of it on the opposite side of the wheel; in the improvement, Mr. Perkins has put one on this side of it, and so arranged, that when the connecting rod and crank are rising toward the dead point, by shifting the lever G on the cam on this side, the steam is immediately re-admitted, driving the piston back, before it reaches the top of the cylinder, the force of which reverses the motion.

The following are among the advantages that result from the use of this engine. First,—Its *perfect safety*, resulting from the immense strength of the generating tubes; and should it be possible to burst them, that effect would, in all probability, take place without displacing a single brick in the furnace. Second,—A *reduced consumption of fuel*, equal to one half. Third,—Its *diminished bulk*;—and Fourth,—Its greatly *reduced cost* when compared to other engines, and the facility of making repairs.

The following proportions of the engine may, perhaps, be acceptable information:—

The power is calculated to be equal to 30 horses. The fly wheel 8 ft. diameter,—weight 28 cwt. Diameter of piston 8, in.—stroke 20 in. Circumference middle of connecting rod 10 in.—length of do. 3 ft. 7 in. Circumference of piston rod $6\frac{3}{4}$ in. Do. of steam pipes, BD, fig. 1. $5\frac{1}{2}$ in. The remaining minute parts may be examined by the scale for both drawings, attached to fig. 1.

Mr. Perkins's method of showing the power of his engine, (the accuracy of which he does not conceive equal to that of pumping or

* Mr. Perkins has a very novel and effectual mode of accomplishing this, which we were confidentially made acquainted with, but are not warranted in disclosing at present. [*Editor of the Register.*

grinding, neither of which were convenient for him to adopt,) was, however, near enough to show great economy in the consumption of fuel; it is as follows. A strong lever is made to press on the periphery of the fly wheel, the long arm of which is eight times the length of the short; and on the end of the long arm of the lever weights are suspended. Its best action I will now state: the steam at 800 lbs. pressure per square inch, being admitted into the cylinder, and shut off when the piston had made one-eighth of its stroke, it made an average of 60 strokes per minute. The weight on the end of the lever was full 300 lbs. from which *deduct two-thirds, for the difference between weight and friction, which was found by experiment to be within a fraction of correct*, and the following calculation will show the extraordinary result.

300 lbs. is the weight on the end of the lever; this being multiplied by 8, the difference between the long and short arm, gives 2,400 lbs. as a constant pressure on the periphery of the wheel.

This wheel being 25 ft. in circumference, and making 60 revolutions per minute, gives (25×60) 1,500 feet velocity per minute.

1500	feet velocity, multiplied by
2400	the pounds pressing on the wheel,
3,600,000	gives This multiplied by the minutes in an hour,
60	
3)216,000,000	produces which, divided by 3, the difference between
72,000,000.	weight and friction, gives

Whence it would appear that 72,000,000 lbs. was raised one foot high with 42 lbs. of coal, which was the amount consumed each hour.*

This method of testing the power of the engine is not so erroneous as some appear to imagine. To ascertain the difference between this kind of friction and weight, the wheel was fixed, and a given weight (using the same rubbing surfaces) was made to move with about the same velocity, as the wheel moved in the experiment. A weight being suspended over a pulley drawing the weighted lever horizontally, it was found that one pound would give motion to three. Many experiments have been made at different densities, and the results went to prove that the higher the steam was compressed, the greater was the saving of fuel; for it takes but very little more fuel to generate steam of 50 atmospheres, than that of 25.

I cannot close without expressing the great obligations I am under to Mr. Perkins for the very handsome manner in which he has furnished me with the information necessary to enable me to make this communication; and for the obliging readiness he displayed in the full explanation of his interesting and useful improvements.

I remain, Sir, yours respectfully,

CHRISTOPHER DAVY.

[*Ibid.*

* This, I believe, is only about 1-5th of the consumption of Boulton and Watt's engines.

Account of the first comparative trial of Mr. Perkins's New Steam Engine.

We have the pleasure of announcing, that Mr. Perkins has at length, in a very satisfactory manner, proved the superiority of his newly constructed high pressure steam engine, by working it against two other steam engines, upon the low pressure principle.

This small engine, which we have several times mentioned in our present volume, has been, within these few days, set up at St. Catherine's Dock, and employed in pumping water from the excavation. There have been four steam engines engaged in the prosecution of these works; two for excavation, and two for pumping out the water. Mr. Perkins's engine stands along side a low pressure engine, of sixteen horse power, which is determined by the area of its piston.

The diameter of the piston, that is, the bore of the steam cylinder of the new high pressure safety engine, is eight inches, and its stroke twenty inches. It was connected, by gear, to a beam that made sixteen vibrations per minute, and raised two alternating pump buckets, the diameters of which are fourteen inches, and their strokes three feet three inches.

We were extremely anxious to communicate our observations on the effect and action of this engine, but the first time of its working can hardly be considered to be a fair criterion of its capability. We understand that it is expected to perform twenty strokes per minute, and will then, it is said, lift 900 gallons of water every minute. Our limits will not allow us to say more upon this subject at present, but we intend to take a more deliberate view of the engine in a few days, when it gets fully into action. We think it important, however, to subjoin the following certificates, which speak for themselves, and require no comment from us.

"We, the undersigned, certify, that there are two low pressure steam engines, employed night and day in discharging the water which flows into St. Catherine's Dock, from the land-springs, &c.; that one of them is a sixteen, and the other a ten horse engine. We also certify, that Mr. Perkins has recently put up a small high pressure steam engine, the diameter of whose piston is eight inches, its stroke twenty inches; and that we have seen this engine pump the same quantity of water from the Docks which has been heretofore pumped by the other two."

James Lamon,
Pearson Woodward,
Thomas Browne.

"I, the undersigned, certify that I have superintended, and put up, Mr. Perkins's high pressure safety engine. I also certify that what is stated by the above engineers is true, and that it was done with only 42 lbs. of coal per hour. Having been engaged twenty two years in making and putting up engines, principally in Cornwall, it is not likely that I could be deceived as to the power and efficacy of this engine; and I confidently believe, that two thirds of the coals used in this country might be saved by the use of this engine."

Henry Hornblower.

"I, the undersigned, carefully weighed the coals, and placed them under Mr. Perkins's generator: and certify, that 42 lbs. wt. of coals only, was used per hour. I also certify, that what is stated by the above engineers respecting the work done, is true." W. Herne.

Mr. Perkins is of opinion that the two low pressure engines could not have been worked up to their full power, although they used the full quantity of coal, three and a quarter bushels per hour; but admitting they worked at only two thirds of the power, there would be a saving of about three fourths of the coal consumed in low pressure engines, by the employment of Mr. Perkins's new principle.

[*Newton's Journal.*

On the new High-pressure Steam-engine, constructed by Jacob Perkins, *Esq. Civil Engineer, London.*

The Editor was highly gratified on Wednesday, the 10th ult., (July) by witnessing the performance of this engine at the St. Catherine's Docks, where, as Mr. Hornblower, (a nephew of the celebrated Mr. Hornblower,) the intelligent engineer and superintendent of it, informed him, it had been incessantly at work, night and day, from 12 o'clock on the Friday night preceding, and had, alone, kept the excavations free from water, although the river had once made an entrance to a very considerable extent.

At the time the Editor saw it, it was working two pumps; but, owing to its having got the water so completely under, it was then drawing air mixed with the water.

Mr. Hornblower stated, that it was then working at a pressure of about 270 lbs. upon the square inch, it not being one-third of its full power; and that it only consumed at the rate of one bushel of coals per hour; but that it ordinarily did the work of a 12-horse engine.

Its motion was exceedingly rapid, and indeed it was necessary to abate its velocity by the introduction of a pinion, fixed upon its main-shaft, working into a larger toothed wheel upon the crank-shaft which actuated the pumps; and, owing to its working with so great a velocity, one of the great advantages of working high-pressure steam, the engine itself is of a very light construction, not requiring such massive shafts, &c., to be employed, as in the ordinary cases of the low-pressure steam-engines.

Mr. Hornblower stated, that another engine employed to drain the excavations, consumed two and a half bushels of coals per hour.

[*Gill's Technological Repository.*

Remarks on the phenomenon in the emission of Steam, discovered by M. Clement, and on its influence upon Safety Valves. By J. Perkins, *Esq.*

TO THE EDITOR OF THE LONDON JOURNAL OF ARTS, &c.

Sir—Seeing in your Journal the report of a paper, presented by M. Clement, to the Royal Academy of Science, in Paris, on a newly

observed phenomenon connected with steam valves, (see p. 97) I have thought it desirable to request your insertion of the following remarks upon M. Clement's discovery, consisting of my own views on that subject, and of, I think, a satisfactory explanation of the phenomenon, which, by the general tenure of his paper, appears not to have occurred to M. Clement.

M. Clement, in his communication to the Royal Academy of Science, in Paris, on some singular results observed by him, connected with steam, observes, that when steam is greatly compressed in a boiler, so that a strong current is made to blow out through a small orifice, on a metal plate, or disc, being presented at a little distance from the orifice, it is forcibly repulsed; but if it is brought near, and pressed, so as nearly to close the orifice, and cause the steam to escape in a radiant direction, or star-like form, round the outside of the disc, an external pressure will be found to act upon the disc, and it can only be set at liberty by forcibly raising it.

The phenomenon in steam, observed by M. Clement, is very curious, and at first sight appears unnatural; but nevertheless it is truly philosophical. In experimenting on high steam, particularly on the phenomenon of its rushing from the stop cock at so much lower a temperature than when in the generator, I observed that a strong current of air was constantly rushing into the stream of steam, and passing off with it, which was proved not only by its taking into its current atoms of dust, but also by its drawing, at a distance of six or eight inches, the flame of a candle from its wick. This current of air would, of course, cool down the steam, and that in proportion to its velocity. Knowing this fact, it is easy to understand the cause of the disc being pressed so strongly against the aperture.

The steam passes off horizontally in every direction, as M. Clement observes, in a star-light form; now as a strong current of air will be created by the velocity of the steam, and pass off with it, the surrounding air will follow, and in its course it will impinge on the disc and cause a pressure, and that in proportion to the height or velocity of the steam. When the safety valve is so constructed, which is sometimes the case, as to allow the steam to pass off in a horizontal direction, the pressure will be much greater than when the valve is conical, which gives a different direction to the steam, making it more difficult for the air to impinge on the valve. The valve placed on the generator of the high pressure safety engine is so small, and so nearly cylindrical, that the stream, when it issues from the valve, causes the molecules of steam immediately to join and form one volume, carrying the current of air upwards, as the steam passes nearly perpendicularly. No air can, of course, come in contact with the valve, and probably a partial vacuum would be made immediately over it. This evil may be very easily remedied, by obliging the steam to rush into a tube rising twelve inches, or more, above the valve. In fact all steam boats are provided with a steam box, into which the steam rushes, which necessarily prevents the current of air from acting on the valve. The steam issuing from the safety

valve would then pass off perpendicularly, and prevent the admission of the atmospheric air, which created the pressure on the disc, observed by Mr. C. Mr. Penn, of Greenwich, has a valve affixed to his high pressure boiler, and it is so constructed as to have the steam pass off horizontally. Mr. P.'s son informed me, that he has observed the mercury to indicate an increase of from 80 to 100lbs. per inch, after the steam began to escape from the safety valve; it was undoubtedly from the above-mentioned cause. Science is much indebted to M. Clement for his discovery, for although this phenomenon has been observed in strong jets of water rushing from a fountain, as well as in strong currents of air rushing from the blower of a blast furnace, yet M. Clement is, undoubtedly, the first who observed it in steam, and also the first who has warned the public of the danger of using this kind of safety valve.

I am, Sir, yours, &c.

J. Perkins.

Fleet-street, London.

ENGLISH PATENTS.

Wass's Patent Improved Furnace for rendering the smelting of lead ores, and other mineral substances, innoxious to the surrounding neighbourhood; and by which the volatile products are condensed and preserved.

Mr. Jeffrey of Bristol obtained a patent for a very effectual mode of condensing the deleterious vapours arising from the smelting of metals, in which contrivance it is, however, necessary to have a constant stream or shower of water from the top of the chimney shaft. But as a sufficient current of water can be obtained in comparatively few situations, the improved arrangements of the patentee (Mr. Joseph Wass, of Ashover, Derbyshire,) become especially deserving the attention of persons engaged in smelting works generally: for in addition to the advantage of obviating the injurious effects upon vegetable and animal life within the range of the metallic vapours, there results, from the adoption of this improved construction of furnace, a considerable profit; which arises from the product obtained by the condensation of those volatile and deleterious particles that are usually allowed to mix with the atmosphere. In the specification before us the patentee says, and we believe with perfect truth, that—"By the employment of this improved apparatus, smelting and calcining furnaces are divested of their pernicious effects, and such works may in future be erected in any convenient situation, either near to dwelling houses, or by the side of public roads, or on the banks of navigable rivers, or canals; and thus, in many cases, produce a very great economy in the expense of carriage. The saving effected by this apparatus in preserving a quantity of valuable

matter, which would otherwise, as heretofore, escape, to the injury of the neighbourhood, would of itself amount in one year, where four furnaces are employed (as described in the plan) to a sum equal to the entire cost of the improved apparatus; that is, the upper part of the tower, with its roof, cap, vane, shutter, and appendages,"—which we shall next proceed to describe.

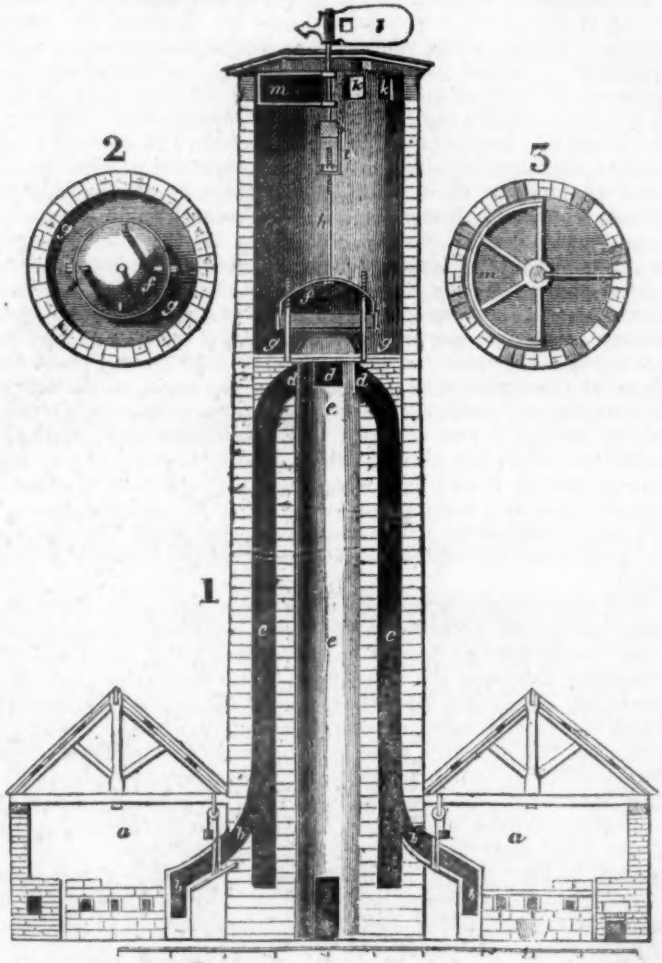


Fig. 1, in the preceding engraving, represents a vertical section of a lofty and capacious tower, placed in the centre of four smelting furnaces, and receiving, by distinct flues, the smoke and vapour from

each of them. The drawing being a *central* section, but two of the furnaces are brought into view, which are marked *a a*, their flues *b b*, opening into separate chimneys *c c*, in the tower, which they ascend for twenty, or more, feet, then by lateral passages, at *d d d*, they respectively enter the central shaft *e e:* here the vapours come in contact with a powerful ascending current of cold air, and are likewise checked in their upward progress, by striking against a dome or cap of iron *f*, which is suspended over the throat of the central shaft *e*. The ascending vapours, thus intercepted and acted upon, are, for the most part, immediately condensed, and the metallic particles are precipitated upon a floor *g*, called the *lodge floor*. A plan of this floor, and the cap *f*, are given in a separate figure (2), which is a transverse horizontal section of the tower, just above the cap; another advantage resulting from this arrangement, consists in the effect produced in the furnaces below, where it is found that the carbonaceous matter is more completely consumed than by the former disposition of things. Such portion of the heavy particles that do not fall upon the lodge floor, are precipitated to the bottom of the central shaft. The cap *f* is suspended by a vertical rod *h*, which is connected to a transverse beam, by means of a sort of stirrup-iron *i*, through which the upper extremity of the rod is screwed, and by the turning of a nut upon this screw, the height of the cap above the throat of the central shaft, is regulated. The cap is steadied in its movements, and preserved in its position, by several upright bars passing through it, two of which are brought into view; these are perforated with holes, through which, keys or bolts are put, to lock the cap securely in its place. The lower part of the cap or dome is circumscribed by a broad hoop; by the action of regulating screws, this hoop is shifted up or down over the periphery of the cap, and the passage for the vapours is thus more readily adjusted at pleasure.

The more volatile portion of the vapours pass from under the dome, and ascend to the top of the tower, which being covered with a roof nearly flat, the heaviest particles are driven back, and fall condensed also upon the lodge floor, while the lightest and least pernicious, escape into the atmosphere at the lateral openings *k k*. There is a regular series of vent holes all round this part of the tower, one half of which, those that happen to be to windward, are always closed by a circular shutter *m*. The lower extremity of the shaft, upon which the vane *l* is fixed, turns in a bearing upon the cross beam; and the arms of the circular shutter being also attached to this shaft, when the wind turns the vane, the shutter is, consequently, in like manner turned against it. Fig. 3 is a transverse section of the tower immediately under the roof, by which the circular frame of the shutter is shown, as closing one half of the apertures, or those to windward of it.

When the deposition from the condensed vapour has become considerable, it is removed from the lodge floor, at a time when the

smelting furnaces are not at work. This is done by a man ascending a narrow circular staircase, constructed in the masonry of the tower, up to the lodge floor, where he throws down the accumulated deposition, with a shovel, to the bottom of the shaft; from thence it is barrowed out, and carried to a roasting furnace.

When any one of the furnaces is not at work, communication with the tower is to be cut off by means of a damper, as those shown at *o o*.

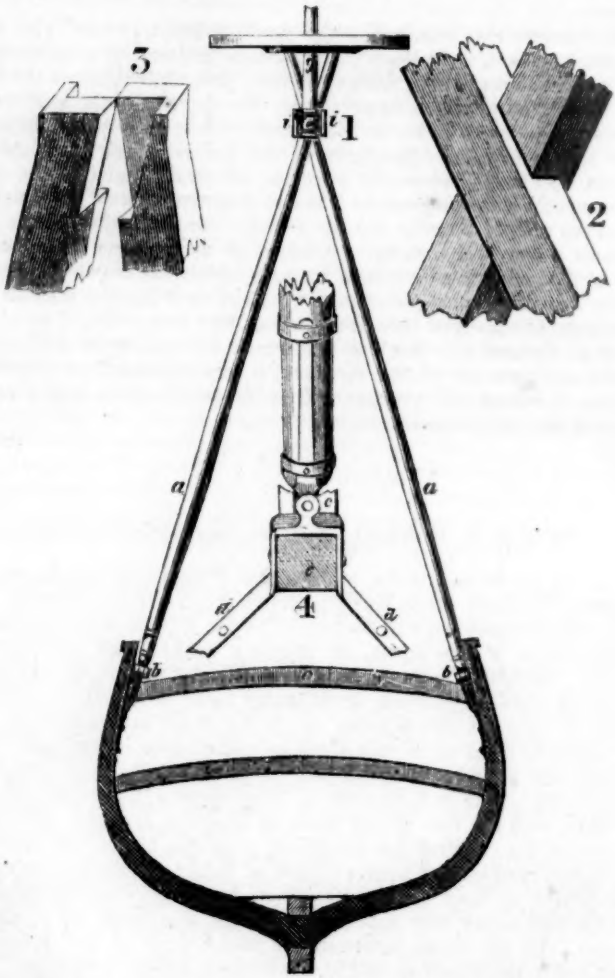
In the drawings attached to the specification, a general plan of a smelting work is delineated. The area is inclosed by a quadrangular wall, with a smelting furnace on each side, the chimneys of which are conducted into the central tower. The corners of the quadrangle are occupied by the other buildings required in such establishments. The spaces between the angles of the several flues, the patentee states, may be conveniently occupied by small furnaces for tests and experimental purposes. Another improvement of the patentee deserves mentioning; he directs that the tapping sides of the contiguous furnaces be made 'opposite' to each other; by which is meant that they may both face the area which lies between them, in order that the fluid metal from the pans of each furnace may be run into pigs, or conveyed into one receiver, and thence into a mould, so as to be formed into thick sheets, ready for milling or rolling: by which arrangement of the furnaces, it is considered an important saving of labour and expense will be effected, and the waste, by remelting the lead, avoided.

[*Ib.*

Patent to T. R. Guppy, Esq. for Substitutes for Masts.

These are termed in the specification, "improvements in masting vessels;" we have taken leave to call them *substitutes for masts*, and it is with pleasure we add that we think the substitutes very superior contrivances to the latter, as respects convenience and general utility. Instead of a single pole fixed into the keel of the vessel, in nearly a vertical position, constituting what is called a mast, the patentee employs two poles or spars, the lower end or heel of each of which is fixed on to the opposite extremities of the beam of a vessel, and likewise to the sides; the poles are then so inclined to one another, as to be connected at their upper extremities, and thus to form, with the line of the deck, an isosceles triangle: this is the outline of the construction as applied to sloops, or ordinary fore and aft rigged vessels. For square rigged, or larger vessels, the poles are not joined at their upper extremities, but at several feet below it, where they cross one another, presenting the figure of a pair of shears. In all cases, however, the lower ends of the poles are fastened in the situation, and in the manner before mentioned. Thus situated, they are invested with the important property, or capability, of being lowered forward or aft, as occasion may render desirable,

by the introduction of hinge joints, at their extremities, close to the deck. At the junction of the poles above, suitable arrangements are made for setting top-masts thereon, which are provided with gear for that purpose, as well as for the masting of other vessels, for loading or unloading a vessel, and for other purposes to which *shears* are usually employed on board of ships.



The principal rigging for these "double pole masts" will be the fore and aft stays, the ordinary side shrouds being comparatively unimportant, except for the purpose of going aloft.

At Fig. 1, *a a*, are the two poles, having joints at *b b*, from whence proceeds a strong iron band which clasps the opposite ends of the beam *c*, which, underneath, diverges into two iron straps that are bolted to the sides of the vessel. This will be clearly understood by an examination of Fig. 4, which gives a perspective side view of the iron work which connects the poles to the vessel, with a portion of the beam, and a pole; *c c* is the beam, with the iron band bolted to it, and showing the straps *d d* that are secured to the sides of the vessel, and are turned for that purpose flat ways towards them. The poles are connected together at *e* by a stout iron band, by scarfing and crossing each other, as shown by the separate Fig. 2 in perspective: *f* is the top, where the upper ends of the poles are strongly secured to one another by straps and bolts: *g* is the lower end of the topmast which passes through a hole adapted to it in the top, with its heel resting upon an iron projection, which is of one piece with the band *e*.

For sloops, and fore and aft rigged vessels generally, the poles *a a* terminate at their junction, and are united by scarfing, previous to putting on the strong iron band. The mode of scarfing, the patentee leaves to the genius of the mast-maker, but at the same time points out *one* mode which he most approves of, and which, perhaps, cannot be excelled: this mode is shown by the perspective Fig. 3. Connected to the band which unites the poles together, are fixed long iron links, *i i*, for hooking on, or "*seizing*" the shrouds to.

Those of our readers who may desire further information, may consult the Repertory of Patent Inventions, for November last.

[*Ib.*

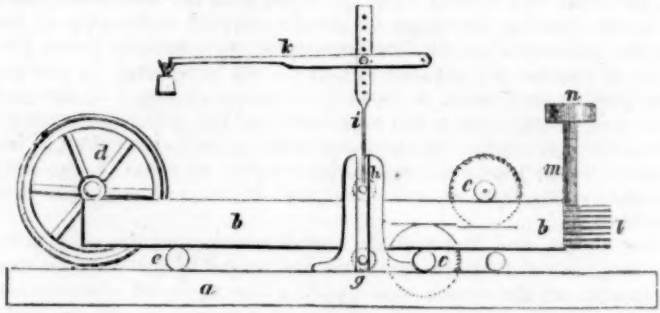
Patent granted to George Sayner and John Greenwood, for Improved Sawing Machinery.

The improvements in Saw-mills projected under this patent, relate to three distinct particulars; each of them presumed to be an improved application of the circular saw.

The first, and the most important, consists in the employment of two circular saws, instead of one, to cut through a piece of timber. According to the usual method, in sawing through a log of two feet in thickness, a circular saw of about five feet in diameter is required, as the cut cannot extend to the full semi-diameter of the saw, on account of its axis and the strengthening flanch; but by the new arrangement of the patentees, the operation is accomplished by two saws, each of little more than half the diameter of the former; they are placed therefore on opposite sides of the timber, where each of them makes an incision rather more than half way through; the log is thus divided completely, effecting at the same time a very considerable saving in expense of power, and in the cost of saws.

The annexed diagram will, we trust, be found sufficient to explain the matter, clearly: *a* the bed of the saw-mill; *b b* the log of timber

under operation: *c c* the two circular saws, the depths of their respective cuts being shown by two fine lines; these saws have pulleys upon their axes, and are driven by bands which embrace them, and the drum wheel *d*, motion being given to the latter by a water wheel, steam engine, or other power.



The timber rests, and moves, upon horizontal rollers *e e*, and is guided accurately to the saws by vertical rollers, (not shown in the engraving), as usual in saw mills. The axes of the saws running in fixed bearings, the timber is forced against them by the propelling roller *g*, which is caused to revolve by another band from the drum wheel *d*, the axis of the roller being confined by the upright frame at *g:* in the upper part of this frame is also situated the axis of the *pressing roller h*, which being connected to the vertical bar *i*, is pressed upon by the weighted lever *k;* the roller *g*, therefore, gives the motion, and the roller *h*, a steady firmness to the advancing position of the log.

If the timber is to be cut into planks, a number of circular saws are placed together on the axes of *c c*, with flanches between them of the thickness of the intended planks, and bolted together; by these means, the whole log is, at one operation, formed into boards; and if it be required to cut the log into scantling, or laths, a series of horizontal saws *l* placed, in like manner, upon a vertical axis *m*, and driven by the pulley *n*, cuts the whole at once into those small divisions. This mode of applying the saws to work in a horizontal plane, so as to operate simultaneously with those acting in a vertical direction, is the *second particular* improvement alluded to at the commencement of this article.

The third improvement claimed, is for uniting the plates of a series of saws closely together, so as to make one compact body of saws, without any interstices between them, for the purpose of reducing dye-woods entirely to saw dust, or powder, instead of the usual method of chipping or rasping them for the purposes of dying, or other chemical operations.

[*Ib.*

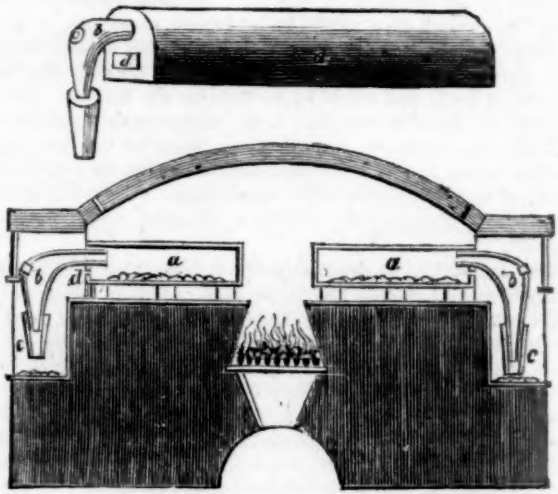
Patent granted to Mr. Benecke, Verdigris Manufacturer, and Messrs. Shears, Coppersmiths, for an Improved process in preparing Zinc or Spelter.

In the ordinary method of preparing zinc, or spelter, the ore is exposed to the heat of a furnace, in a melting pot, from the bottom of which a pipe descends into a vessel of water, for the purpose of receiving the metals as they are melted, and for condensing such portions as pass off in the form of vapour. An improvement upon this mode was the subject of a patent about fifteen years ago, in which it was so arranged, that as the zinc volatilized, the vapour should be received, and condensed, in a separate vessel, leaving the melted metal, such as lead, and other impurities, in the former. Now the new process we have to describe, is an improvement upon the latter mode; it consists, firstly, in a peculiar treatment of the ore, previous to its introduction into the furnace; and secondly, in a peculiar arrangement of the retorts and other appendages, by which a more convenient mode of charging the retorts is obtained, and a purer metal is the result.

The ores are first to be roasted in the ordinary way, by stratifying them with fuel, and setting fire to the pile. The ore is next spread out in the air, and lixiviated, to separate the sulphate of zinc; it is next to be dried, pulverized, and roasted a second time, until the sulphur is extricated; when it should be powdered again, and mixed with an equal quantity of carbonaceous matters, such as powdered coal, charcoal, cinders, &c.; in this state it is to be saturated with an alkaline ley, or a solution of common salt; the solutions varying, according to the nature of the ore. Calamine, or other oxides of zinc, will require only to be pulverized and calcined.

With the ores prepared, as before mentioned, the retorts are to be charged; one of these is shown in perspective at *a* in the annexed figure; they are made of fire clay, or such earth as will best stand the heat of the furnace. To the front end of these retorts, are two apertures; the upper, circular, for the reception of the neck of an earthen head piece *b;* the lower, *d*, is square, for clearing out the residuums after working, which is closed during the distillation, by a stopper, and luted. The head piece has likewise another tube fitted to it, and luted, merely for the purpose of lengthening it, sufficiently to allow the vapour to cool as it descends, and to condense upon an iron-plate beneath, as shown in the lowest figure in the diagram; which represents a cross or vertical section of a reverberatory furnace, in which a double row of such retorts may be supposed to be arranged, with a long aperture between them where the fire is situated, which rests upon a grating over an arched passage, that communicates with the open air outside the building: this arched passage has a door, by the opening and shutting of which the heat of the furnace is regulated as may be required: and through one of the ends of this long furnace an aperture is made for supplying it with fuel.

The earthen head pieces, *b b*, it will be observed, have an aperture supplied with a stopper; through these openings, the ore and carbon, prepared as before mentioned, are introduced in sufficient quantity, by means of a ladle, into the body of the retort; when the apertures are closed and luted. The operation of distillation then commences; the zinc which rises in vapour passes into the head pieces, *b b*, down the pipes *c c*, and falls upon the iron plates beneath, in a condensed state.



By the arrangement described, the head and neck of each retort is placed in a square recess or neck by itself, by walls built out between them, so that each may be perfectly closed in, by a door, from wall to wall. The doors are made of latticed wire work, for the purpose of holding clay when plastered over them, for the purpose of effectually confining the heat within the furnace; each of these doors has a central eye hole, provided also with a stopper, for watching the progress of the operation, and for enabling the workmen to determine the degree of heat to be applied, and other circumstances.

By another arrangement, the Patentees propose to erect furnaces, with several tiers of cylindrical retorts, placed one above another, with their necks or heads projecting beyond the front wall. The fire place is *covered* by a low arch, to prevent the fire acting too violently upon the lowermost vessels; but through the arch, apertures are made for the circulation of the heated air among the vessels above.

[*Ib.*

To CHARLES FREUND, *of Bell Lane, Spitalfields, in the County of Middlesex, Sugar Refiner, for his Discovery of an Improvement or Improvements, in the process of Refining Sugar.*

THE improved process employed by the patentee for refining sugar, which he denominates clearing the pans, is intended to supersede the present practice of using bullock's blood, and such other albuminous matters; and consists in the application of pot, or pearl ash, and fuller's earth, to the sugar in the boiler or pans, as a means of removing the colouring matter.

The process is as follows:—In the pan usually employed for boiling the sugar, a quantity of water is placed, say eighty-four gallons, to which fifteen pounds of American pot or pearl ash is to be put, and to these, eighteen hundred weight of raw, or Muscovado sugar is to be added. This compound having been well stirred, to break the lumps, mix the whole perfectly together; from twenty to thirty pounds of the whitest fuller's earth, dissolved in water to the consistency of cream, is now to be added, and the whole well agitated during the boiling process, and fresh water introduced as the process goes on, to keep the sirop in a sufficiently fluid state.

As this clarifying process goes on, the boiling is to be occasionally suspended, for the purpose of removing the scum, which will float upon the surface, and when the boiling has been continued for a sufficient time, the sirop is to be withdrawn in the usual way, and placed in a vessel for the purpose of settling.

This vessel is to be furnished with three cocks at different heights from the bottom, by means of which the sirop is to be withdrawn as it becomes settled, and clear: drawing, of course, from the upper cock first, after it has stood perhaps twelve hours to settle, and the next day from the second cock, and so on, until as much has been drawn as will run clear.

The vessel is then to be tilted, which may be done by depressing one end, and for this purpose it is erected upon a frame supported by an axle, placed a little distance from the centre, the other end of the frame being sustained by a leg which is a screw. In the first instance the vessel is placed perfectly level, but when the sirop has been drawn off, down to the level of the lower cock, then the vessel may be tilted by turning the screw leg, and the remainder of the sirop drawn off as long as it will run clear.

The remainder of the sirop, with the sediment, may be ultimately withdrawn, by removing a screw plug, placed in the bottom, and this with the scum, or any other thick or coloured sirop, may be again put into the clearing pan, and operated upon as described above.

The patentee states, that his claim of invention is simply the employment of pot or pearl ash, or other such vegetable alkaline matter, with fuller's earth, for the clarification of sugar, and that the same is applicable to clarifying of sugar, or molasses, in different states, that is, it will apply to the clarification of the raw Muscovado sugar,

to the bastards, and to the molasses, all of which purposes come within the meaning of his patent right.—Enrolled January, 1826.

[*Newton's Journal.*

ESSAYS ON LITHOGRAPHY. No. III.

Lithographic Crayons for Drawing on Stone.

It is impossible to obtain beautiful lithographic impressions, if the crayons used by the artist, have not the requisite qualities. The ingredients of which they are composed, ought to be of such a nature as to adhere firmly to the stone, after the design has undergone the preparation by the acid, as well as during the process of drawing it. They ought to be sufficiently hard to admit of being brought to a very fine point, and to allow the artist to make clear, and well-defined lines, without the danger of breaking it off. If they are made too dry or porous, they are subject to break very frequently; if too soft, they crumble, and will only form coarse and confused lines, making it impossible to produce a drawing possessing character and neatness. It would be rendering a great service to Lithography to discover the means of forming crayons as hard as those made of black lead, so as to be able to trace, on stone, lines as fine, and clear, as those made with these pencils. It is in fact an improvement, which the art yet requires. The following composition, however, is, in the present state of Lithography, found to answer the purpose.

Soap, from suet, or tallow,—dry -	150 parts.
White wax, free from tallow - -	150
Lamp black - - - - -	25

The soap and the wax are to be put into a covered skillet, on a brisk fire; and when the whole is perfectly melted, the lamp black is thrown in, a little at a time, taking care to stir the mixture continually. The common lamp black of commerce, may answer, without its being necessary to calcine it; but when, as is sometimes the case, it contains particles of sand, or earth, it must be rejected; it ought also to be extremely fine. The whole should be allowed to boil, for a few moments, in order that the mixture may be complete; the composition is then poured into a mould of wood, or of brass, which is made to open, and shut, at pleasure, and in which twenty-five or thirty crayons may be formed at once. It is necessary to rub the mould with oil, to prevent the material sticking to it. After having filled it, it is opened, and the crayons removed; it is then closed again, and fresh matter poured in, which must be kept very hot. A flat plate of metal is sometimes used instead of a mould: it must be made warm to prevent the composition cooling too rapidly, and be surrounded by four ledges of wood, in order that the melted mass may not run over the edges; a quantity is then to be poured in sufficient to make the crayons of a convenient thickness. The pieces of wood are immediately removed, and the material is cut, with a

knife, into such strips as to form crayons of the desired size. It is necessary to be very quick in this operation, that the paste may not have time to cool, for in this case it would break under the knife. The crayons thus cut, will separate readily from the plate, if care have been taken to rub it with oil. The formation of air-bubbles is prevented by allowing the boiling to cease for a moment, before pouring out the matter, or by pressing it with a stone, or some other body, that has been made warm.

Lithographers submit the materials which they employ in the composition of their crayons, and even their ink, to the action of burning; but this method is, nevertheless, a very bad one, as in the combustion, a part of them is entirely destroyed, and it is besides impossible always to obtain, with certainty, crayons of the same quality. Some persons pretend that it is necessary to use different kinds of crayons during the progress of the drawings; but, if the artist have a really good crayon, he will find it answer equally well for every part of his work; or the utmost that can be required, is a trifling difference in the degree of hardness given to them; which difference may be effected, by increasing, or diminishing, the quantity of wax in the compound; or by adding to it a little mastic. Another composition has been recommended for crayons called *retouch crayons*, and which are used for repairing those parts of a drawing which are accidentally detached from the stone, during the operation of drawing; but a crayon which is suitable for forming the design in the first instance, will serve equally well for these retouches.

Printing Ink.

This ink differs from that used in typography, in being much thicker. In order to form it, a varnish is made of linseed, or nut oil, with which is ground up a certain quantity of lamp black. The older the oil is, the better is the varnish. This ink should not be too thin, or liquid; nor must it be too strong, or thick. If, when mixed with the lamp black, it be found to possess the first fault, it will extend itself beyond the lines and points which form the drawing, and be widened still more by the action of the roller, or of the press, in obtaining the impressions; and, in the end, would adhere to the stone, or fill the spaces between the lines, notwithstanding the water used to prevent these effects; it will also the more readily be imbibed by those parts of the stone which have not been covered by the crayons, or the ink, used in drawing, which will also be softened, and the harmony of the design be destroyed. If it be too thick, if the lamp black be not well incorporated, or any heterogeneous substances be mixed therewith, it will not take well on the delicate points and lines; it will be apt to break them up, or choke the spaces between them, and unite them together, as they will be liable to crush by the force used in taking the impressions.

The same means are used in making this varnish, as are employed in preparing that which is used for letter press: that is, in an iron or

a copper vessel, a quantity of oil is poured, sufficient for the varnish it is desired to make; taking care that the vessel is not more than two thirds filled: this precaution is indispensably necessary, in order to prevent those accidents which might occur from the oil boiling over. Even in this situation it may suddenly swell up and boil over; it must therefore be carefully watched; and, when necessary, removed quickly from the fire, or it would inflame, to the imminent danger of every one exposed to its action. When the vessel is thus removed, it is generally placed in a hole prepared in the ground, that it may be more quickly cooled. This preparation should be made out of doors, and in a place where no damage can ensue from such an accident. When the oil is boiled in a fire-place, there should be, close at hand, a heap of ashes, ready to throw on the fire, to deaden it. Some persons put litharge into the oil, to render it drying; but ink, which has been thus prepared, hardens too quickly upon the inking stone, and roller; its tenacity will also cause it to adhere too firmly upon the drawing, and may consequently detach its more delicate parts. In preparing the oil, a few pieces of bread are successively thrown into it whilst it is boiling, and these are removed when they assume a brown colour; onions are occasionally used for the same purpose; the advantage in this proceeding is, however, very doubtful.

The oil requires five or six hours boiling, and even more, when there is a great quantity of it. When it begins to boil, the evaporation is accelerated by stirring it, and lading and pouring it back into the vessel with an iron ladle, furnished with a long handle. A lid is at first placed on the vessel, to hasten the heating of the oil. The oil is to be inflamed at three or four different times, taking care to extinguish it when it burns too fiercely; this may be done by blowing upon it, by placing the cover upon the vessel, and, if necessary, by removing it from the fire. The fire is applied to the oil, by means of a piece of flaming wood, or paper, which is brought near to its surface; if the liquid does not take fire, it is a proof that it is not yet sufficiently heated. The oil is to be laded up, and poured back again whilst it is burning. All these operations should be performed with great care, to avoid injury from the fire, and more particularly from the boiling oil, which burns severely wherever it touches.

In order to ascertain when the oil is boiled enough, and the varnish has acquired the requisite degree of consistence, a few drops are allowed to cool on a piece of glass, or on a plate. When the varnish has been allowed to cool, it ought not to be capable of flowing on the body on which it has been placed; when touched by the finger, it ought, on raising it, to draw out into long threads; and the length of these threads indicates the thickness of the varnish. The consistence of the thinnest varnish, should be a little less than that of common honey; but experience alone can teach the exact degree of thickness which is necessary. For Lithography, two kinds of varnish are in general prepared; one, thick, intended for crayon drawings, the other thinner, for designs in ink; and when it is desired to have one of an intermediate quality, these two are mixed together. These varnishes may be kept in the vessels in which they were made, or in glazed

jars; care being taken to cover them closely. If the varnish has been boiled until it is too thick, it may be made thinner, when necessary, by warming it a little, and mixing with it a certain quantity of linseed oil. It may also be tempered without heating it, by rubbing it up with a little oil; observing that only a very small quantity must be used, otherwise it will spread on the impressions, and thus spoil them. A quantity of this varnish, sufficient for a fortnight's work, is taken, and, in small portions at a time, ground up with lamp black, by means of a mullar; carefully observing to cover it, whenever any is taken out for use. The varnish may be thickened, by adding to it a greater quantity of lamp black.

In order to obtain beautiful drawings, a black of the best quality must be used; the lamp black found in the shops, is greasy, and of a brownish colour; and if employed, will produce impressions which will appear dull and rusty. To avoid this inconvenience, that black should be used, which is made of burnt, or rather, carbonized rosin. It is prepared by packing it closely in a crucible, the lid of which is to be luted down with potters' clay; the crucible is then placed in a stove, and covered with lighted charcoal, and thus left until no smoke can be perceived to issue from the interstices around the cover. This black, when taken from the crucible, presents a body sufficiently hard, but friable; it is to be broken on a stone, and pulverized with a mullar, before mixing it with the varnish. Some persons mix with the lamp black, a small quantity of indigo, to give more tone to the proofs; this, however, is not necessary, when the lamp black is of the first quality.

The public taste sometimes requires that prints or designs should be produced in colours. In this case, the colour required is mixed with common varnish. Those which combine with this varnish, are, for blues, indigo, and Prussian blue; and for reds, vermilion, and carmine; this last colour requires to be rubbed up with spirits of turpentine, to enable it to incorporate perfectly with the varnish. The ochres, when they are very fine, may be used for reds, or yellows; and that of the latter colour, when mixed with indigo, will produce a green. Terra di Sienna gives a brown, &c. The greater number of colours, as they are found in the shops, not being sufficiently free from grit, or other gross particles, to produce good ink, it becomes necessary to mix them in fine powder, with a certain portion of water, in which the grosser matter is allowed to subside, and which is then decanted, and left at rest to deposit the washed colour.

Preserving Ink.

When a stone has been drawn on, all those parts which constitute the design, are covered with a thin coat of printing ink; but this ink, being very siccative in its nature, dries after a certain time, and then takes with difficulty, or entirely refuses to receive the ink with which it must be charged, for the purpose of obtaining a new impression. This inconvenience is but little felt in ink drawings; it being only necessary to cover these with a coat of gum, to preserve them for a great length of time. It is not so, however, with drawings executed

in crayons, or with those which are engraved, or with stones intended to produce coloured impressions. These are soon deteriorated, although defended by a coat of gum; they require to be protected by an ink which will always retain its unctuosity. The two following compounds have been found to succeed equally well.

Lithographic varnish, very thick,	2 parts.
Mutton suet, - - -	4
White wax, - - -	1
Oil of turpentine, - -	1
Lamp black, - - -	4

The three first articles are to be melted over a slow fire, when the oil of turpentine is poured in, mixing the whole well together; then is added the lamp black, a little at a time, stirring the mixture until it is formed into a homogeneous paste. The other composition consists of

White wax, - - -	1 part.
Suet, - - - -	2
Oil of turpentine, Lamp black,	as much of each as is necessary to give

a colour and consistency, similar to that of common printing ink.

These inks should be kept in a covered vessel, to preserve them from the dust and air. An inking stone and roller, must be appropriated exclusively to their use. The ink is spread over the stone with the roller; and after having taken an impression of the drawing, it is well cleaned with a damp sponge; it is then charged with the roller, as it would be were another impression wanted; and the stone is then covered with gum water.

In Germany, these precautions are carried to a greater extent. When no more impressions are wanted, and the stone is to be put by for future use, the design is removed from the surface by spirits of turpentine, the stone is cleaned by washing it with water, then inked in the way just described, and then lightly coated with gum water. Before the stone is so disposed of, any spots, or blotches, which may be found upon the drawing, are carefully removed.

When the stone is wanted for new impressions, the gum is first removed, by water and a sponge; the preserving ink is cleaned off by a sponge and spirits of turpentine; the stone is then moistened, and charged with the ordinary printing ink, by means of the roller.

ON GILDING.*

Gilding is an art exercised in various ways, according to the purpose for which it is designed. Its general object is to give to the surface of any article, to which it is applicable, either a matted appearance, or the brilliancy of burnished gold. Wood, plaster, cardpaper, leather, metals, such as iron, tin, silver or bronze, are frequently covered with gold. It is also applied on paper, on the edges and covers of books, and upon many other substances.

* From the Dictionnaire Technologique.

On Gilding in oil.

This is the name given to that species of gilding in which oil is the fluid material used to cause the gold to adhere to the article gilt.

In oil gilding, what is called *gold colour* or *gold size*, is employed, which is no other than what remains of the different oil colours, in the cup in which the artist cleans his pencils. This substance is extremely *fat* and glutinous; after being again well ground, and strained through fine linen, it serves as a foundation, or ground, upon which to lay the gold leaf; this material is to be applied upon a hardened ground of paint, (*teinte dure*) with a common paint brush. The gold size improves by age, as it becomes more fat, or unctuous, the longer it is kept.

The foregoing is the process usually adopted, but we proceed to lay before our readers another, which has been communicated to us by a very skilful operator in this art, and which is to be greatly preferred.

1st. The first operation is to give a priming coat, of colour formed by grinding white lead, in oil rendered drying by boiling with litharge, and tempered afterwards with linseed oil, adding a little fat oil, and a very small portion of spirits of turpentine.

2. Grind *calcined* white lead very fine, in fat oil; this must immediately be tempered with oil of turpentine, as it is subject to become thick very quickly. Three or four thin coats of this are to be given, very evenly, in the ornaments, and on all parts intended to be gilt Care must be taken in applying the colour to the deeper parts of the work, that it may be even and perfect. This is the *teinte dure*, or hard ground, already mentioned.

3. The gold colour, or size, previously strained through fine linen, is then to be laid on, very thin and even, with a soft brush which has been used for oil colours. A smaller brush must be used for the deeper parts of sculptured, or other ornaments, carefully observing to remove any hairs which may be detached from the brush.

4. Where the size is so far dried as to become tacky, the gold leaf is to be spread upon the cushion, and divided with the knife; the gold is placed on with a small block of wood, faced with cloth, called a *palette*, and lightly pressed with cotton, repairing where necessary, with pieces of gold cut small, applied by a badger's hair pencil.

5. If the articles gilt are to be exposed to the weather, as balconies, grating, statues, &c. they ought not to be varnished, as gilding in oil is more durable without, than with, varnish. The heat of the sun, will, after a heavy rain, cause gilding covered with varnish to craze, or crack, over its whole surface. Gilding in the interior of a building, as on the rails of stair cases, &c. should have a coat of spirit of wine varnish, drying it by means of a chafing-dish, and then applying a coat of oil varnish.

6. As the beauty of oil gilding depends greatly upon the manner of varnishing it, this should be particularly described.

The workshop ought to be very warm; the varnish must be spread

gently, and evenly, over the work; and a second workman should follow immediately, and warm the surface by means of a chafing-dish, passing it about constantly, to prevent its heating too much in one place, which would blister the varnish. This heating will cause the gold to appear distinctly, as it will render the varnish perfectly transparent, which might otherwise become white and dull.

When marble is to be gilt, as it is ordinarily polished, it does not require the priming coats. If soiled, it must be made perfectly clean; the parts to be gilt should be covered with a thin coat of good oil varnish, then with the gold size, and afterwards gilt.

Gilding in oil is suitable for domes, the outer ornaments of churches, figures in lead or plaster, grating, balustrades, balconies, &c.; and answers equally well, whether the articles gilt, be exposed to, or defended from, the inclemency of the seasons. Oil gilding, however, is also used on carriages, on furniture, &c. This is called *polished varnish gilding*, and is effected as follows.

A portion of white lead, half as much yellow ochre, and a little litharge are separately ground very fine, and the whole mixed with fat oil, thinned with a little spirits of turpentine. This, which forms the first coat, is to be spread thinly, and evenly, on the work.

When the foregoing coat is perfectly dry, a number of coats of hard ground (*teinte dure*) are to be given, even to ten, or twelve, according to the nature of the work; to render the lower parts smooth, generally requires the greatest number. A day ought to be allowed between each coat, and the article should be kept in a warm place, or exposed to the action of the sun; especial care must be taken that the pores in the recesses of the wood be hidden, as well as in every other part.

When the whole is perfectly dry, the flat parts are rubbed down with a piece of pumice stone and water, and afterwards the whole, with a piece of serge, and finely powdered pumice stone and water, until all the streaks of the paint disappear, and an even, glass-like surface is obtained.

After being thus prepared, four or five coats of fine lac varnish should be given, with a brush of badger's hair; this should be laid on lightly, and in a place moderately warm.

When dry it is to be rubbed down with rushes, both on the pannels and the sculptured parts, and afterwards polished with putty, and with tripoli moistened with water, and applied by means of a piece of serge, until it is as brilliant as glass.

In a place perfectly free from dust, and moderately warm, the polished work is to receive a very light, thin, and even, coat of the gold size; it is impossible to make this last coat too thin, as any sensible thickness would injure the work; the brush must be carefully chosen; it must be very soft, free from all dirt, and with the hairs firmly fixed.

As soon as the size becomes tacky, which may be known by touching the back of the hand against the work, the gilding may be commenced. To cover the broader surfaces, a leaf of the book of gold is to be opened, and the edge of the gold applied to the surface,

with a slight pressure, releasing and laying the whole leaf, in such a way that it may be spread evenly, without tearing, or doubling; this is called gilding from the book. The leaves are thus to be placed side by side, lapping as little as possible, but observing that every part be completely covered. When small surfaces, and carved work are to be gilt, the leaf must be applied by means of cotton, or by a suitable pencil.

The gilding is to be lightly brushed over with a very soft pencil, or rather with a flat brush of badger's hair, of about three fingers width; and it may then be left to harden for several days.

The work is to be varnished, with a spirit varnish, called gold lacker, or with simple seed lac varnish, warming it in the way formerly mentioned.

When the spirit varnish is perfectly dry, it is to be covered by two or three thin coats of white copal oil varnish, or of gold coloured oil varnish, allowing two days between each coat.

Finally, the pannels are to be polished with a piece of serge, covered with tripoli and water, and a lustre given by the palm of the hand, which is to be moistened with a small portion of olive oil, taking care not to injure the gold, by rubbing one part more than another. Those parts of carriages, furniture, or sculptures, which do not admit of being polished, should have a greater number of coats of the spirit of wine varnish, and two, or three, of the oil varnish.

M. Monteloux-Lavilleneuve, of Paris, who has obtained great celebrity for gilding in oil, and for burnishing all kinds of varnished metal, and who has greatly improved this art, received a patent for his improvements, the term for which has expired; the following is an extract from his patent.

After the pieces are varnished and polished, he applies his gilding ground; for this purpose he heats them, and wipes them carefully whilst warm, to render it certain that not the slightest humidity remains upon the parts to be covered with the ground. In this state of perfect dryness, with a small stick, sharpened like a crayon, he places, in spots, small portions of his first ground upon the work, taking care that the quantity on each spot, and their distances from each other, shall be as equal as possible. This part of the operation must be quickly performed, that the drops first applied may not harden, so as to interfere with the perfect and equal spreading of the ground; this spreading is effected immediately, by first using a stump, or roll, of lutestring, and then a piece of velvet, which equalizes it, and diminishes its quantity as much as is necessary. Without this precaution the gold when applied, will appear black, and will lose its brilliancy. This first ground, or size, is composed of equal parts of the gold size, already described, and of boiled oil.

The next operation is to apply, in a similar way, a second coat, formed by combining together two parts of wax, and one of mastic varnish, made with linseed oil: these are to be used without spirits of turpentine. The spreading of this requires that the article should be warmed in a stove.

A third coat is formed, composed of one part of amber varnish,

and two of fat oil, without spirits of turpentine; this, after being laid on with a brush, is to be regulated by the velvet, and some time allowed before the application of the gold. Practice alone can point out the time when it is sufficiently dry for this purpose.

The gold may be applied by means of the small cushion, formed of wood, and faced with cloth, or by a simple card, according to the habit of the workman. When the gold is on, it is to be pressed with a piece of soft skin, and then with clean velvet, in order to give it the uniformity of surface, and the brilliancy required. It is then left to dry in a stove room; after which it may receive one or more coats of oil varnish; taking care that this be not applied, until the gilding has hardened perfectly, otherwise it will absorb a portion of the varnish, and in consequence lose its brilliancy. The varnishing upon gold, preserves it from being rubbed, and renders it capable of being washed, to remove any spots, or dirt, from its surface.

[TO BE CONTINUED.]

Remarks by the Editor.—The experienced workman is generally able to substitute one article for another, in the recipes presented to him; but those who are without experience or skill, are apt to suppose that the process must fail, if there be any departure from what is written down; we add a few remarks for the purpose of correcting this error. The French are in the habit of using the oil gold size, mentioned in the foregoing article; but as it is formed from the various pigments left in the washing of their brushes, it is evident that it must vary in its composition, and in its colour; its use, however, has been consecrated by habit, which is a master of Herculean power The gold size used in England, and in this country, we think a much better article; it is composed of red lead, and fine yellow ochre, ground in fat oil, that is, a thick boiled oil, which has, by age, assumed a fat, unctuous consistence, which gives it a peculiar fitness for this use. Gold size thus made, is of the colour most suitable to hide any defects in the work: it possesses all the good properties of that used by the French, and is free from its bad ones. It may be made in large quantities, and, with proper precaution, be kept for years.

The rushes used for rubbing down, are a valuable article, and grow abundantly in various parts of the Union: they are to be found in our own neighbourhood, in the State of New Jersey; though extensively used in Europe, they are scarcely known to our workmen. They grow usually to the diameter of a small goose quill, are hollow, and on their exterior surfaces, are as sharp as glass paper, whilst they are much finer; they may be used either wet or dry. Glass paper is our substitute, for dry, and powdered pumice stone and water, for wet rushes.

Tripoli, is an earth much used in Europe for polishing, after rushes or pumice stone have been used; we have seen specimens of American earth which possessed all its useful properties; rotten stone is most commonly employed, and answers very well; it ought, however, to be carefully washed

The mode of making gold lacker, and lac varnishes generally, we have heretofore given. What is meant by gold coloured oil varnish, we know not, it is easy, however, to give to white copal varnish, either a red, yellow, or orange tinge, but we should prefer a colourless varnish, as we think it bad taste to alter the beautiful colour of gold, as it exists in the leaf.

Amber varnish we have never used; for most purposes it is inferior to copal, but as a ground for gilding on, it may be superior; the mode of preparing it we shall hereafter describe.

Where work requires much rubbing down, many coats of colour are necessary, but in most instances they may be much less numerous, than directed in the preceding article; in metal they cannot be needed, and in wood, much depends upon the closeness of its grain, and the truth with which it is worked.

A new method of Softening Cast Iron.

To the Editor.

Sir—Having received both amusement and instruction from your valuable journal, I am induced to communicate what appears to me to be a very useful discovery. It is well known, that in casting small articles of iron, the metal will be sometimes so hard, as to resist the file, and all other tools, and is therefore useless; if, however, you take the article, and make it as hot as it will bear, without injury, and put on it a small portion of *brown* sugar, the sugar will spread itself rapidly and curiously, over the iron, will penetrate, and render it as soft as the softest malleable iron, and of course, allow it to be cut, or filed. I am told, that common salt, or borax, will act on the iron in the same way, but not so thoroughly. I have seen the experiment tried on a piece of casting, about eight inches in diameter, and $\frac{3}{4}$ inch thick; only half the iron was highly heated, and the sugar, 2 oz., applied to the heated part; the sugar appeared to go quite through this part of the iron, altering its colour and texture, and making it quite soft; while the other half remained white, hard, and incapable of being wrought. I claim not the merit of the discovery, the fact has been known to a few workmen here, for some months, and the information is, of course, extending; that it may have wider circulation, is the wish of

Yours, &c.

Boston, August 25th, 1827. A Subscriber.

Remarks by the Editor.—We have published the foregoing as we received it; the writer speaks with confidence of the result of the process, and this is the only circumstance which has induced us to insert it. The softening of hard cast iron is, in general, effected either by the addition, or abstraction, of carbon; we do not see how either can be produced by the action of sugar, in the way described: had time and convenience allowed, we would have tried the experiment ourselves; should others do so, we shall be glad to hear the result. Our doubts rest upon theoretical grounds; but should facts be against us we give up our theory without regret.

For the Franklin Journal.

Some account of the rise, progress, and present state, of the Union Canal, of the state of Pennsylvania.

One of the first objects of public improvement which claimed attention in Pennsylvania, was the opening of a communication by water, between the Susquehanna and Schuylkill. More than 50 years ago, surveys were made under the authority of the legislature, in order to ascertain the best route for the purpose; and nearly 36 years have elapsed since Robert Morris, David Rittenhouse, and other patriotic and spirited individuals, associated and commenced the SCHUYLKILL AND SUSQUEHANNA CANAL, upon what was then deemed the most eligible ground. A very large sum was expended upon the work, but from the want of capital in the country, and, more especially, from the inveterate prejudices existing against the undertaking, which was the first of the kind in the United States, its abandonment became inevitable, and the expenditure proved, almost, a total loss.

The project was subsequently revived under the name of the UNION CANAL, by the praiseworthy industry of the late Mr. Paleski, but it was not until the year 1821, that efficient means were provided to give reasonable assurance of its accomplishment. From that period, the work has been carried on with vigour and perseverance, and its completion being near at hand, the following particulars relative to it will be found interesting.

The Union Canal begins, on its eastern end, in the works of the *Schuylkill Navigation*, about two miles below the town of Reading; ascends along the western shore of the Schuylkill to the valley of the Tulpehochen, and passes up that valley to the east end of the summit, within five miles of Lebanon, rising 311 feet by locks of different lifts, from four and a half, to eight feet each. The summit level extends six miles 78 chains, part of which is by a tunnel 729 feet in length, 18 feet wide, and 14 feet in height, which opens into the valley of Clark's Creek, along which it descends to the Swatara river, and continuing along the valley of the last mentioned stream, it terminates at Middletown on the Susquehanna, where it joins the east end of the great Pennsylvania canal. The descent from the summit, to the Pennsylvania canal, is 192¼ feet, which is overcome by thirty-seven locks of various lifts.

The whole length of the canal is about 79 miles, exclusive of the navigable feeder of seven miles, which extends up the Swatara, towards the extensive and valuable coal beds on the sources of that stream. The excavation of the trunk of the canal, much of which is through solid rock, is entirely finished; the tunnel which surpasses in length any in the United States,—two reservoirs at the summit containing 12,000,000 of cubic feet of water,—a dam across the Schuylkill at Reading, which gives a fine harbour to that flourishing town, and two dams across the Swatara, for the purpose of feeding the canal, are completed. All the other works, usually incident to such

an undertaking, excepting the toll-houses and fences, are likewise finished, and consist of 43 waste wiers—49 culverts—135 road and farm bridges—12 aqueducts, one of which is 276 feet in length, and another 175 feet;—two guard locks of wood, and 92 lift locks of cut stone, principally cemented with Pennsylvania water lime. Besides the particulars here enumerated, solid protecting walls have been constructed, to the extent of fourteen miles in length, in situations where the pressure of contiguous streams is occasionally dangerous; a feeder upwards of four miles long, and lined throughout with plank, has been made, and extensive works, similar to those at Fair Mount, are erected on the Swatara, for supplying water to the summit. One of the wheels of this establishment is thirty-six feet in diameter, and works two double forcing pumps, at the same time. The other wheel is twenty-one feet five inches, in diameter, and works two pumps in the same way. In addition to these, the company are erecting two steam engines of one hundred horse power each, to be worked with anthracite coal, and to be used for raising water in case of necessity.

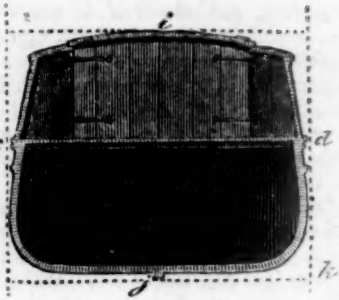
The parts of the canal east and west of the summit, have been navigated for several months past, and the water was recently let into the summit so that one boat crossed it, and passed from the Schuylkill to the Susquehanna; but this part of the canal, being through a lime-stone region, was found too porous to be relied upon. In consequence of this difficulty, the company are now engaged in planking the parts which appear to require it, and in puddling some parts anew.* These measures and some parts of the machinery for elevating the water, are all that remain unfinished, and it is understood that the company look forward, with confidence, to the middle of November, as the period for the canal to be put into full operation.

The Union Canal is 24 feet wide at bottom, has 4 feet depth of water, and 36 feet water surface. The towing path is ten feet wide, and is raised eighteen inches above the top water line. The locks are 8½ feet wide, and 75 feet long, between the gates, and are adapted to pass boats of 25 tons.

We are aware that much exception is taken to the width of the locks upon this canal, which are according to what is termed the "small system" of navigation; but when it is considered that locks of this size, if fully employed, are capable of passing nearly 4000 tons in each 24 hours, and that in England, the most useful and important, as well as the most lucrative canals, have locks of even a smaller size, we cannot but conclude that the day must be very remote when the trade of Pennsylvania will be greater than can be passed by the locks of this canal.

* Planking is by no means an unusual expedient; it has been frequently resorted to in England, and has been found necessary upon several parts of the New York and Schuylkill canals.

FIG. 1.



The foregoing account of the Union Canal, although not official, is derived from a source upon which entire reliance may be placed. We annex a description and engraving of the boats used upon this canal. The cross section, fig. 1, in the margin, is on a scale of one-fifth of an inch to the foot; the side, and deck views, figs. 2 and 3, one-eighth of an inch.

These boats are of 25 tons burden, and their dimensions are as follow:—

Length from	*a* to *b*	67 feet.
Width out to out	*c* to *d*	8 feet 3 inches.
Length of stern deck	*h* to *b*	5 feet.
Length of bow deck	*a* to *g*	9 feet.
Length of covering	*g* to *h*	51 feet 6 inches.
Greatest width inside in the clear,		7 feet 6 inches.
Width in the clear at the gunnel,		7 feet 3 inches.
Depth inside in the clear from the floor to the cover,		6 feet.
Depth out to out, from the top of the gunnel to the bottom of the keel	*d* to *k*	4 feet.
Depth from the gunnel to the keel inside,		3 feet 6 inches.
Forward hatch,		5 feet by 4 feet.
Middle hatch,		5 feet by 6 feet.
Stern hatch,		4 feet by 4 feet.

A boat of the above description, loaded with 25 tons, will draw 3 feet of water, and will require one horse, and the attendance of one man and one boy. Where coal or other articles not liable to be injured by wet, are to be carried, the cover will not be necessary, and of course, the sides will not be carried higher than *c d* in the draught of the cross section.

Fig. 4 exhibits the canal boats mentioned by Mr. James Stott, in his communication, p. 117, showing how they pass along the canal, and through the locks. They have been long used to advantage, on the late duke of Bridgewater's Canal, from his coal works in Worsley to Manchester, and upon several other canals in England, for a series of years; and are considered as well adapted for the navigation from Mount Carbon, and for coal, and other boats on the Union Canal; as may be seen by reference to Mr. Stott's paper.

The gangways 1, 1, 1, 1, and the stages, 2, 2, (for the horses while crossing at the dams) are only temporary, and are removed while loading and unloading the boats. The boats are chained together in the locks; one man can manage them with ease; the boy, who drives the horse, lets the water into the lock, &c.

FIG. 2.

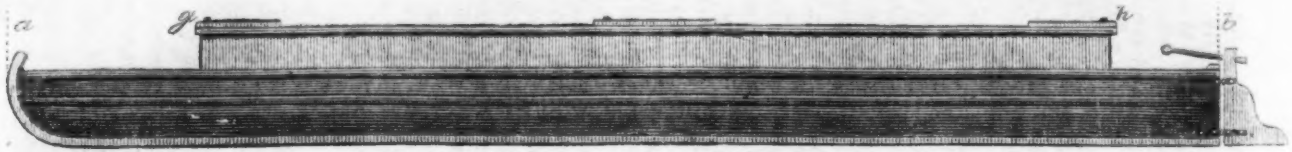


FIG. 3.

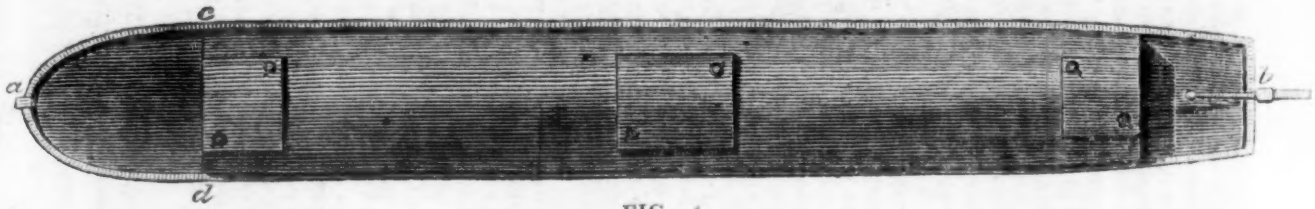
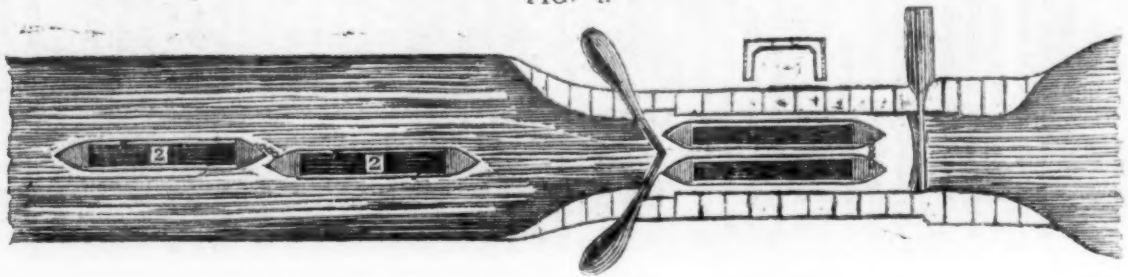


FIG. 4.



FOR THE FRANKLIN JOURNAL.

On a mode of conducting the transportation, on railways, and arranging the passing places, to avoid the necessity of a double set of tracks.

A CONSIDERATION of great importance in forming a railway, is the provision which must be made for carriages, moving in opposite directions, to pass each other. In canals, no provision of this kind is required, as a canal must, necessarily, to insure the banks from being washed away by the disturbance of the water, and to bring the resistance to the traction within proper limits, be sufficiently wide to permit two boats to pass abreast, every where upon the levels.

With a railway, on the contrary, each carriage occupies the whole of one set of tracks, and to enable another carriage to pass it, resort must be had to a second set of tracks. These may be formed through the whole course of the line, or through parts of the line, at short intervals; the carriages passing from one branch to the other by turning platforms or other contrivances, which it is not my purpose now to examine. It may be observed, however, that no mode of forming these, that is, of uniting the branches to the main tracks, has yet been devised, not manifestly liable to derangement, so as, in some degree, to endanger the safety of the carriages. This, together with their cost, has prevented judicious engineers from recommending them to be placed nearer than one quarter of a mile from each other. Hence if long railways, such as are already projected in various parts of our country, to answer the general purposes of transportation, be made to consist of single sets of tracks, with passing places at intervals, only, it must be evident that if the transportation be conducted in the usual method, it must be constantly interrupted by the carriages meeting at the intervals between the passing places.

To form an idea of the delays and vexations which would arise on a railway of this kind, for the transportation between a great agricultural district and the sea board, let us suppose one of our great roads to be walled up on both sides, leaving merely width of way for a single carriage, between the walls, except at intervals of a quarter of a mile; at which points, only, a sufficient width should be provided for carriages to pass each other. Would a person enter, between these straight walls, with any confidence that he should arrive at the passing place without meeting some other carriage and being obliged to return, himself, or compel the other carriage to retreat before him, to the next passing place? The question is answered almost instinctively. Yet the difficulty of passing in opposite directions, on such a road, would be no greater than that to which carriages would be subjected on a railway, constructed in the manner above described. A carriage, on a railway, can no more leave its proper tracks, than it can pass through a wall of iron. The cases, so far as passing is concerned, are precisely similar.

Mr. Tredgold has shown that it can never be expedient to form a railway unless there be an assurance of 100 tons, to pass over it,

every day, as the transportation of a less quantity than this, taking the interest on the cost of the railway as fairly chargeable to the expense of transportation, can be performed for about the same price on common roads. To enable the proprietors of a railway, therefore, to fix the tolls at so low a rate that the public may derive a clear and decided benefit from its formation, will require a transportation of 200 tons a day, on the average of the year. But as this would be constantly fluctuating, it must sometimes happen that, in the busy seasons, it would be necessary to carry 500 or 600 tons a day. To carry 500 tons would require about 72 horses; allowing 7 tons to a horse, besides the weight of the carriages. As these would be divided equally in the two directions, let us suppose 36 horses, with their trains of wagons, to pass, in one direction, at unequal intervals, any given point on a railway in 24 hours. A carriage moving, at the same velocity in an opposite direction, must meet them in 12 hours; and this meeting, if the distances of the trains, from each other, were determined altogether by chance, would be, at an average of 1-8th of a mile from a passing place; taking the passing places to be 1-4th of a mile asunder. Then, the velocity of carriages, laoded thus heavily, being 3 miles an hour, the delay at each meeting, for the approaching carriage to arrive at the passing place, must be 2 1-2 minutes; and as the obligation to wait would fall, indiscriminately, on carriages in either direction, it is a fair presumption that the single carriage, which I suppose to be passing in an opposite direction to the 36 other trains, will be obliged to wait 18 times in the 36 meetings. The delay, therefore, from this cause, would be 45 minutes. It would likewise require, at least a minute, on an average, to clear and arrange the turning branches at each of the 36 meetings, making a total delay of about 1 hour and 21 minutes, in a distance which would otherwise have been passed in 12 hours. The hinderance to a single carriage, or the train of carriages drawn by a single horse, as here stated, must clearly happen to every carriage passing, at that time, on the railway. Nor is this all, for the different velocities of the carriages, making it necessary for some to pass others, although going in the same direction, would be another fruitful source of confusion and delay. Great as this view of the circumstances of transportation, on a single set of tracks, shows the difficulties attending it, practice will be far from showing those difficulties to be less. Indeed when we add to the actual delay, the necessity which the carriers will be under, to watch for each other, to send avant couriers to see that the next defile is passable (thus making it necessary to confine their journeys to broad day light;) it would seem that the vexations and delays that all this would occasion, must detract very much from the usefulness of this means of transportation.

To avoid the difficulties above stated, and various others, two entire sets of tracks have been provided to most of the larger railways of Great Britain. "They commonly make two sets of tracks," says Dupin, *Force commercial, tome* 1, p. 154, "side by side, one for the carriages to go, and the other for them to return;" and to show that

this is thought by engineers a judicious and necessary practice, I may cite the following from the Edinburgh Encyclopedia, No. 31, p. 307. "In laying out a public railway, a breadth of not less than twenty feet should always be contemplated, so as to admit of two entire set of tracks, with the necessary sides, paths and drains. In a private road with one set of tracks, a space of twelve feet in breadth may be found sufficient; but in this case it is generally necessary to make provision for about four passing places in each mile. But this description of road should seldom be resorted to for a public railway, against which the inconvenience of the heavy drag at the turns of the passing places, and the frequent stoppage of the wagons, should prove sufficient objections."

But the formation of even a double set of tracks, is not sufficient for a great railway, on which it is every way desirable to carry passengers, as well as freight, to run coaches as well as wagons; the latter, from their heavier loads, going, necessarily, much slower than the former. The double tracks provide perfectly for the opposite directions, but from the higher velocity of the coaches, they will occasionally overtake, and must pass the wagons. Branches from one set of tracks to the other must be made for this purpose; and as these can be only at fixed points, the same interruption, to the free passage of the coaches, will, in a more limited degree, occur, that I have before enumerated as certain to happen on a single set of tracks, used by carriages passing in opposite directions. Taking the example of a railway of 100 miles in length, and supposing 36 trains of wagons to enter upon each set of tracks in a day, and to travel $66\frac{2}{3}$ miles, or 3 miles an hour, exclusive of stops for changing horses; we have the equivalent of 54 such trains upon the whole course of such set of tracks, at one time. The velocity of these trains of wagons being 3 miles an hour; a coach going 9 miles an hour, must pass 36 of these trains in the course of its route, or in 12 hours; allowing one hour for necessary stops. With passing places at each quarter of a mile, a coach would be obliged to check its speed to conform to that of the wagons, 36 times a day, and to travel, upon an average, one eighth of a mile, each time, at the rate of 3 miles an hour. This, if not an evil of such magnitude as that before stated, as inevitable to passing in opposite directions on a single set of tracks, must yet appear as a vexation which it would be exceedingly desirable to avoid.

I have been thus particular in stating the conditions under which transportation, of all kinds, upon railways is practised, for the purpose of proposing a mode of conducting it which does not appear to have been acted upon systematically in England, and which would seem to obviate the difficulties I have enumerated, without the cost of a double set of tracks, or even of passing places, except at distances of several miles.

The method I propose, is to use a single set of tracks, and simply to confine the entrance of the carriages, upon their routes, to certain fixed periods, and to prescribe to them certain velocities. By this means, the exact places of meeting could be determined, and proper provision made for passing.

Take an example of a railway 100 miles long, and suppose that coaches, to travel 9 miles an hour, and wagons, to go 3 miles, enter upon their journeys, at both ends of the railway, after intervals of 12 hours only. The wagons in one direction would meet those of an opposite direction, at the distances of $16\frac{2}{3}$, $33\frac{1}{3}$, 50, $66\frac{2}{3}$ and $83\frac{1}{3}$ miles, allowing always for necessary stops, from either end of the railway. The coaches would meet the opposite coaches, midway, and they would meet trains of wagons at the distances of 25 and 75 miles from either end of the railway. The number of passing places, therefore, would be eight in 100 miles, and if the velocities and times were accurately conformed to, each carriage would be subjected to a hinderance of 8 minutes only, to clear and adjust the turning branches. There can be little doubt, that the carriages could be made to arrive at the passing places, within a minute of the fixed time. But as the passing places would fall at distances proper for changing horses, 10 or 15 minutes might be allowed for a belated train to arrive. A longer time than this would, probably, rarely, if ever, be necessary, unless on the occurrence of some disaster to the railway, such as would interrupt the transportation, though conducted in any other way.

It must be necessary, to any general railway, to form lateral branches, to pass through the country in various directions. Conformably to the system here proposed, the time of entering from these, upon the main track, should coincide with the arrival of the regular trains of carriages, of similar velocity, at the junction of the branches with the main tracks. This arrangement would be very simple, and would, apparently, occasion neither confusion nor delay.

For the purpose of rendering the proposed method clearly understood, I have assumed certain numerical velocities and intervals between the periods of starting. But these would, of course, be made to suit the circumstances of the route. A third velocity, between that of the coaches and wagons, might be assigned, should the public convenience require it. So, also, on parts of the railway which should deviate much from a level, the passing places should be arranged, in distance, to permit the descending carriages to travel with a higher velocity than the ascending.

The advantages of conducting transportation, on a single set of tracks, by this method, over that of suffering the carriages to pass at all times, and with all possible velocities, will I think, be evident, on a fair and careful examination. It is not, perhaps, too much to assume, that transportation could be conducted with as few vexations and hinderances, by this method, on a single set of tracks, as it would be by a double set, letting the carriages enter at all times, considering the difficulties, which would arise, from the various velocities with which they would perform their journeys. Under this view, the saving would nearly equal the cost of an entire set of tracks.

It may be assumed, by some, that it would be a great convenience to travellers, to be able to commence their journeys, and to traders, to send their goods, at all times. A little reflection will show this to be of very small moment. When we now undertake a journey, we

find no difficulty in making our time of commencing it, to conform to the period fixed for the starting of the coach, or the steam-boat, and for sending goods, we could make our arrangements to conform, in the same way, without any inconvenience. It would, in truth, be a great advantage, peculiar to this system, that the loads of produce would arrive at the destined market at certain known periods. This would enable the traders, of all kinds, to be in the market at the time, to conclude their bargains at once, and be free to manage their other concerns. Amongst other incidental advantages, of this method, would be that of repairing the railway conveniently, and without interrupting the transportation; for as there would be long intervals of time, when no carriages would pass any point requiring repairs, the rails could be taken up, or any work performed, which would, from its nature, render the railway impassable. Again, the drivers and attendants on the long train of carriages, which would thus be brought together, would, in case of accident, insure immediate assistance to repair any damage, or to remove a broken carriage from the railway, if necessary, to provide for the seasonable arrival of the rest.

D. T.

August 22, 1827.

Description of a method of testing the quickness of Gunpowder. By Joshua Shaw, Esq.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir,—Encouraged by your publication of my former remarks upon gunpowder, I am induced to offer some further observations on the same subject. Although much has been said upon the property of quickness in gunpowder, I am not aware that any accurate mode of testing it, has ever been offered to the public. The mode mentioned in your number for July, as communicated by captain Baird to the author of the Shooter's Manual, is not to be depended on; the inequality of a loose train of powder, however carefully laid, and the liability of the eye to be deceived, amidst the volume of smoke which accompanies the combustion, are unavoidable sources of error.

I have before advocated the opinion, that since the general introduction of the percussion gun, quickness is a property in powder, much less desirable than formerly, as regards the sportsman; but in a military point of view, and as long as the match, or partlight, shall remain in use, this property will be of great importance; it is more particularly so in national armed vessels, in which the undulations produced by the motion of the waves, are every moment shifting the position of the guns, and consequently the time required for slow powder to burn through the depth of the touch-hole, would render the firing uncertain.

In mere trials of skill, when the mind is at liberty, a tolerable calculation can be made, to meet these variations; but, I presume,

that, in the heat and hurry of an engagement, few persons are so collected, as to make them with equal certainty; under these circumstances, therefore, quickness becomes all important, and a positive mode of testing it, must be acceptable to those who superintend this department of the public service, as well as to those who manufacture the article.

My experiments were made with a common fowling piece; this was lashed firmly in a horizontal position, at the height of about five feet from the ground; when loaded, an equal quantity of each kind of powder was used, and the balls carefully fitted to the calibre. At about three yards from the muzzle of the gun, a target was placed, which consisted of a frame made of pine, and placed vertically; this frame was furnished with grooves, and in these, a pannel was made to slide very freely; to one end of the pannel, a line was attached, which passed over a pulley, at one end of the frame, so that the pannel might be drawn from one end to the other, along the grooves, by means of a weight, suspended by the line. On allowing this weight to act, the pannel moved with great velocity, particularly by the time it had travelled three or four feet, at which period, and just as the foremost part of the pannel came in a line with the muzzle of the gun, a button was contrived to strike a wire connected with the trigger, and instantaneously fired the piece. To ascertain the quickness of the powder, it was only necessary to observe how far the pannel had traversed from the point where it first came in a line with the gun, until the ball passed through it.

I constructed this apparatus in the year 1814; my principal object was to test the advantages afforded by using, with the percussion gun, the *copper caps*, or *primers*, which I had then invented. My first experiment was in firing, alternately, at the sliding pannel, or target, with the flint, and the percussion gun. With the latter, it traversed only 2¼ inches, the ball breaking in at the same hole in several successive shots. With the flint lock, it traversed from nine to eleven inches. I next tried in the flint lock gun the comparative difference of powder, from different manufacturers. With Hervey's, the pannel traversed only eight inches; and with the slowest I could procure, thirteen inches. With Pigou's, from nine to eleven inches, as before stated.

I next tried the slowest against the quickest, in the percussion gun, and was surprised to find how nearly they approached each other. With the quickest, the pannel traversed 2 inches; with the slowest, three inches; from this I drew the conclusion that the slowest powder was much the safest, in the percussion gun; and I found that, when good, it was equally clean. With respect to some other advantages which the percussion gun possesses over the flint lock gun, and which I had intended to notice, I find by your last number, that I have been anticipated by Mr. Samuel Nock, of London, who is nephew to the Mr. Nock who invented the first patent breech.

Before closing this article, I wish to call the attention of the public, and more particularly of those concerned in the national marine, to the great advantages which may be derived by some simple applica-

tion of the percussion priming to heavy guns, used at sea. Where national interest and honour are at stake, it surely becomes the duty of those in responsible situations, not to neglect any means which may tend to their promotion.

I have recently made experiments with a new kind of wadding, and have succeeded in producing some important results, which I propose to communicate, at an early day.

Yours, &c.

JOSHUA SHAW.

Philadelphia, Sept. 15, 1827.

On Dying with Prussian Blue.

IN p. 57, of our first volume, we gave a process for dying with Prussian blue, for which a patent had been obtained in England. This, according to the method there described, is effected by dissolving the prussiate of iron, *(Prussian blue)* in muriatic acid, and using a mordant of alum. A different method of using the same material has been proposed in France, by M. Raymond, professor of chemistry at Lyons, and has been published in the *Journal des Connoissances:* by this valuable process, it is said that a brilliant and permanent colour is produced; more bright, and equally deep, with those obtained from indigo, whilst it will also furnish a sky-blue, not attainable from that substance, which is likewise more costly.

To dye silk of a Raymond blue, it is to be cleansed in a large quantity of water, after the usual boiling with soap; it is then to be immersed in a solution of persulphate of iron, (that is, of that kind of copperas, which is of a dark green colour,) the oxide of which will combine with the silk; the greater or less intensity of the shade of yellow which the silk acquires, will furnish the means of judging when a proper quantity of the ferruginous solution has been absorbed; after which it is to be rinsed with great care, to remove all the free acid; the silk is then to be immersed in a bath of prussiate of potash, acidulated by sulphuric acid. In a few minutes the dying will be completed; when this is effected, it must be rinsed in clear water, and brightened with purified urine, diluted with a large portion of water, into which is occasionally thrown a small portion of acetic acid, to guard against a too powerful action of the alkali.

The only difficulty which has yet been experienced in dying with Prussian blue, has been to obtain, at will, a regular gradation of shades, between the most intense blue, and a perfect white. M. Raymond, jun. has sent to the society for the encouragement of arts, patterns of every shade obtainable from indigo; but it has not yet been proved that the process is applicable in the large way.

M. Chevreul has recently read to the Institute, a memoir upon a process remarkable for its simplicity, by which he has lately obtained a perfect gradation in the shades of colour dyed by Prussian blue, which are at the same time, more permanent, and more beautiful

than those from indigo. This chemist, after repeating the fruitless attempts of his predecessors, is convinced, that from indigo alone, it is impossible to obtain the various shades of pure blue, the materials employed with the indigo changing the colour, so as to incline it, more or less, to a purplish or greenish hue.

The following is the method pursued by M. Chevreul in graduating the shades from Prussian blue: he impregnates each of the different parcels of silk to be dyed, with different proportions of the oxide of iron, by immersing them in solutions, the strength of which has been previously regulated. For the deeper tones of colour, he employs the acetate, and for the others, the muriate or sulphate; after having properly rinsed each of the parcels, they are dipped into distinct vessels, or baths of the prussiate of potash, the proportion of which has been made to correspond with the quantity of oxide of iron previously united to each portion of silk. By these precautions he obtains all the desired shades; those, however, which are light, are apt to have a greenish hue; but M. Chevreul found, that on washing them sufficiently in river water, the blue shade was obtained in perfect purity. When the washing did not completely produce this effect, a very weak solution of muriatic acid, was found to remove the yellow matter which deteriorated the blue, and produced the tinge of green.

Method of packing seeds for transportation, so that they may retain their vegetative property.

The lovers of plants, or those who wish to have seeds transported to distant countries, ought to observe the precautions which follow, in order that the seeds may germinate, when they have been sown. The means of effecting this, which we are about to make known, are those which have been followed by that distinguished botanist M. Soulange Bodin, who has had long experience in this business.

All seeds intended for transportation, should be collected in a state of perfect maturity. The finer seeds may be enclosed in good paper bags, but those which are larger, must be placed, in layers, in very dry sand, and the whole packed in air tight vessels. The stratification in dry sand, is a precaution which alone would preserve their germinating property for many years, and during the longest voyages. Saw dust is also a good article, but it is necessary to take the precaution of placing it in an oven, as we do bran, when we wish to purify it from mites, or from the eggs of other insects. Oleaginous seeds, which are liable soon to become rancid, such as those of the coffee plant, the oak, nut trees, the tea tree, &c. require, when stratified, to be kept with great care separate from each other, in sand which is very fine, and very dry. Those which are of a middle size, may be sent in their pericarps, enclosed air tight in small cups, or pots, by covers of glass, fixed on with putty; or of wood or cork, imbedded in melted wax, or, which is better, in melted pitch.

Juicy seeds must be separated from each other, as contact would,

sooner or later, inevitably cause a fermentation which would destroy them. Roxburg dips them into a solution of gum arabic; this, as it hardens, forms a coat which defends them against every principle of destruction, and enables him to transmit them from the Coromandel coast, to Europe, without undergoing the slightest change.

With respect to bulbous roots, and other plants with roots, which always require a length of from two to three feet in their shoots, or slips, it is best to place them either in earth, taken from the spot where the plant vegetates freely, or in some other earth well divided and mixed, and rather too dry, than too moist; the mould formed of the rotten trunks of trees is very good for the purpose; but it is necessary to ascertain that it does not contain insects.

Vegetables treated in this way, have been brought by M. Perrottet from the South Sea, and have all lived. The whole may be inclosed in little wooden casks well hooped, and covered, inside and out, with a bituminous coating. So situated, seeds are unalterable; and when the vessels are well closed, neither insects, external air, moisture, or even heat, can gain admittance. It is above all things necessary (notwithstanding some ill founded theories) to be careful not to use fresh moss, or immersion in wax, or in pitch; plants sent in this way, from the torrid zone, to France, have arrived either decayed, or quite dried up. [*Journal des Connoissances.*

AMERICAN PATENTS.

Description of a machine called the Wheel-wright's Assistant, for the purpose of boring felloes and naves, or hubs, and of forming tenons: for which a patent had been obtained by John Setton of Pendleton, S. C., Feb. 1827.

We have not a drawing of Mr. Setton's machine, and to give a clear idea of a complex instrument by description alone, is a rare talent; from that furnished to us by the patentee, the object and utility of the apparatus will be evident, although its precise form may not be fully understood.

A frame, similar to that called the wheel-gallows, is made, for the purpose of securing the hub to be bored; the top piece of this frame is secured by screws of wood or iron, instead of the common key wedge, which allows it to be raised, or lowered, at pleasure. A bench and frame are placed at right angles with that upon which the hub is secured. Upon this, a carriage is made to traverse backwards and forwards, being confined in its place by ledges, rebates, or grooves; this carriage is about a foot long, and at the top of it is a perforation from end to end, to receive the shank of the augur, which is turned by means of a crank. The carriage is drawn forward by a weight attached to a line, and passing over a pulley, and when the hole is bored of a sufficient depth, a treadle serves to draw

the carriage back. On the opposite side of the hub, the bench is continued, and supports a second carriage, similar to that described, but so inclined as to give, in boring, the intended dish to the wheel. Two persons may bore at the same time, on these opposite sides, and will be able to effect the whole in four minutes. The patent augur is the best, but other kinds may be used.

Before the hub is secured by the screws, it is raised to its place by square blocks; on the upper one, a plate of iron is fixed, marked so as to show the number of holes to be bored, and a tack is driven into the hub, to guide in turning it round to a proper distance. A pin passes through the centre of the nave, and blocks, to preserve it in its place. The holes in the felloes, to receive the spokes, and those in the ends for the dowells, are bored in the same way, there being such appendages as are proper for fixing them, for the purpose of boring with truth.

To cut the tenons, and shoulders, on the spokes, the wheel is put into the frame, and fastened, as for boring the nave; the tenon, or hollow augur, is put into the carriage; this is hollowed the exact size for the tenon, and the outer end is of cast-steel, formed for cutting in a proper manner. There are suitable contrivances for holding the spokes steady, and a stop when the boring is of the proper depth, so as to insure a true circle in the wheel.

This machine will lay off, and bore the nave; lay off, and bore the felloes, cut the tenon and shoulders on the spokes, more correctly, than can be done by measurement: the spokes are the stronger from being shouldered on both sides. With this machine, a good hand can make a wheel in five and a half hours, after being furnished with the nave, turned, and the spokes and felloes, in the rough.

Abstract of the specification of a patent obtained by Denison Olmsted, Esq., of New Haven, Connecticut, for the use of a new material for the manufacture of gas, for the purpose of illumination. June, 1827.

The material which I employ, and the use of which I claim as my discovery, is the seed of the cotton plant; this, after being dried, or roasted, for the purpose of expelling from it the watery particles, I put into a retort, or other recipient, similar to those used for the making of gas from coal, tar, oil, or other substances, in which it is heated to a degree sufficient to convert the oily matter into vapour; which vapour, before its escape from the recipient into the gasometer, is converted into a permanently elastic fluid, by being made to pass over an ignited metallic surface, in the way adopted in the making of gas from oil, or other substances.

In the conversion of the oily matter of the cotton seed, into gas, I do not specify any particular form of apparatus, that already in use being sufficient for this purpose; but I do claim as my exclusive

right, the employment of cotton seed, for the production, by distructive distillation, of a permanently elastic, and highly illuminating gas: the same being my invention and discovery, and not heretofore practised or known.

D. O.

NOTICES.

The series of Essays on Bleaching, and that on Earthenware and Porcelain, will be completed in the present volume; for this purpose we are compelled to extend them a page or two beyond the limits that we ordinarily assign to our longest articles, which is six pages. Their merit, and the importance of the subjects on which they treat, must apologize for their length.

Some of our subscribers have expressed a wish that we would increase the number of our short articles; this wish shall be attended to in our future numbers, particularly as it will gratify a class whose interest we have at heart,—the mechanics.

In the preface to our last volume, we mentioned that a plan had been devised, which was likely to afford the means of increasing the embellishments and utility of our Journal; the present number may evince the success of this plan, and those which follow will bear the same testimony.

Air Furnace. In vol. ii. p. 298, we published the description, and gave figures, of White and Sowerby's patent air furnace. Three persons, at least, we know, have erected furnaces upon that plan; in each of these instances, the iron was fused with uncommon facility, but it chilled on the bed of the furnace, and could not be kept at a temperature to enable it to flow freely. From the account of the patentees, it answered well in their hands: can any of our readers point out the fault in structure, or in management, which has produce the failure with us?

New edition of back numbers.—The new edition of the third volume will be complete in a few days; immediately after which, the first number of the first volume, will be reprinted. Complete sets may then be had, and those subscribers who have not received all the numbers of the third volume, shall be supplied therewith.